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# Energy Research Abstracts

Abstracts 7193-10601

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UNITED STATES DEPARTMENT OF ENERGY

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# ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through the Energy Data Information System (EDIS) maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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## ABOUT *ENERGY RESEARCH ABSTRACTS*

*Energy Research Abstracts (ERA)* provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 13-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

*ERA* is comprehensive in its subject scope, encompassing DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

Information in *ERA* is available for on-line searching as part of the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401. *ERA* is also available at authorized Depository Libraries.

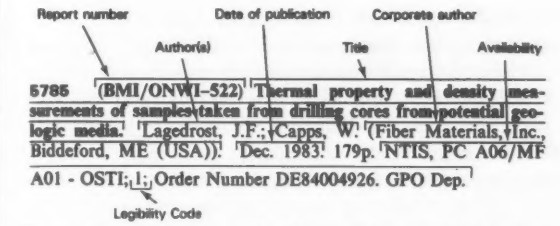
*ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

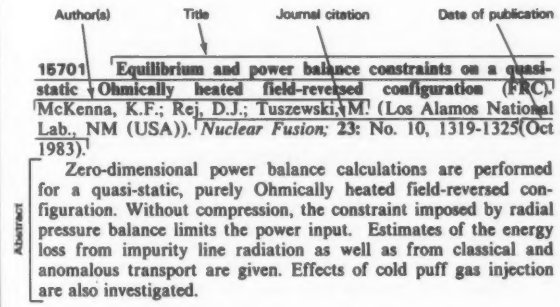
*Managing Editor,* Audrey B. Smith
*Technical Editor,* M. Catherine Grissom

**Office of Scientific and Technical Information**
**United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831**

## ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01 - OSTI; 1; Order Number DE84004926. GPO Dep.
Legibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

## INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

### • Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

**5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

**Fiber Materials, Inc., Biddeford, ME (USA)**

### • Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**Capps, W.,** *See* Lagedrost, J. F.
**Lagedrost, J.F.,** Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**McKenna, K.F.,** Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
**Rej, D.J.,** *See* McKenna, K.F.
**Tuszewski, M.,** *See* McKenna, K.F.

### • Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

**SALT DEPOSITS**
**Density**
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**REVERSED-FIELD PINCH**
**Energy Balance**
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

### • Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

| | | |
|---|---|---|
| **AC06-76RL01830** | **Fiber Materials, Inc., Biddeford, ME (USA)** | |
| | 9:5785 | BMI/ONWI-522 |

### • Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

| | | |
|---|---|---|
| **BMI/ONWI-522** | 9:5785 | NTIS, PC A09/MF A01. OSTI Order Number DE84004926, Distribution Category MN-70 |

# INFORMATION SOURCES

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

Canada
Denmark
Finland
France
Federal Republic of Germany
Italy
Japan
The Netherlands
Norway
Spain
Sweden
United Kingdom
United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 75 countries and 14 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, OSTI both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a data base for on-line retrieval. The data base serves as well for the production of numerous OSTI publications.

# SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6.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- 04 Processing
- 05 By-Products
- 06 Properties
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves and Exploration
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- 70 Legislation and Regulations

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- 10 Legislation and Regulation
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- 05 Health and Safety
- 06 Marketing and Economics
- 07 Waste Management
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- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Combustion
- 50 Storage

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- 02 Site Geology and Hydrology
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- 04 Oil Production, Recovery, and Refining
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- 08 Marketing and Economics
- 09 Waste Research and Management
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**05 NUCLEAR FUELS**
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- 04 Feed Processing
- 05 Uranium Enrichment
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
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- 10 Marketing, Economics, and By-Products
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- 50 Safeguards, Inspection, and Accountability
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**07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY**
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- 03 Isotopic Power Supplies
- 04 Economics

**08 HYDROGEN**
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- 06 Industrial and Commercial Use
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- 03 Geothermal Exploration and Exploration Technology
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- 05 Economic and Financial Aspects
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- 10 Direct Energy Utilization
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- 03 Regulations
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**20 ELECTRIC POWER ENGINEERING**
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- 02 Environmental Control Technology
- 03 Power Transmission and Distribution

**21 NUCLEAR POWER PLANTS**
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- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
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- 30 Policy, Legislation, and Regulation
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# ENERGY RESEARCH ABSTRACTS

## 01 COAL AND COAL PRODUCTS

**7193 (DOE/EIA—0118(87)) Coal production, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 5 Dec 1988. 171p. NTIS, PC A08/MF A01 - GPO - OSTI. Order Number DE89004451/JAW.

Coal Production 1987 provides comprehensive information about US coal production, the number of mines, prices, productivity, employment, reserves, and stocks to a wide audience including Congress, federal and state agencies, the coal industry, and the general public. The data presented in this report were collected and published by the Energy Information Administration (EIA), to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. The 1987 coal production and related data presented in this report were obtained from Form EIA-7A, "Coal Production Report," from companies owning mining operations that produced, processed, or prepared 10,000 or more short tons of coal in 1987. This survey originated at the Bureau of Mines, US Department of the Interior. In 1977, the responsibility for taking the survey was transferred to the EIA under the Department of Energy Organization Act (P.L. 95-91). The data cover 3667 of the 4770 US coal mining operations active in 1987. These mining operations accounted for over 99 percent of total US coal production and represented 77 percent of all US coal mining operations in 1987. This issue is the 12th annual report published by EIA and continues the series formerly included as a chapter in the Minerals Yearbook published by the Bureau of Mines. This report also includes data for the demonstrated reserve base of coal in the United States on January 1, 1988. This is the eighth annual summary on minable coal, pursuant to Section 801 of Public Law 95-620. 18 figs., 105 tabs.

### 0103 Preparation

*REFER ALSO TO CITATION(S) 7195, 7224, 7230, 7234*

**7194 (CMRC—82/18-T) Beneficiation of western Canada's low rank coals.** Butcher, S.G. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). Mar 1982. 20p. (CE—01965). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

High volatile bituminous and subbituminous coal represent half of Canada's coal reserves. Subbituminous coals are presently used raw at minemouth generating stations. Foothills high volatile bituminous coal be mined at a relatively low cost. Thus export as prepared thermal coal is commercially attractive, but preparation costs are high. the run-of-mine coal is a three component system: coal with a high inherent moisture, soft shales and clays. Conventional washing results in large volumes of tailings, and the clean coal requires thermal drying. One alternative beneficiation scheme being investigted is thermal drying the raw coal and cleaning by dry gravimetric separation. Economic evaluation shows significant savings in waste disposal by elimination of tailings dewatering, but overall there is a need for improved dry separators. Pilot scale tests have established conditions under which raw and washed coals can be dried to below equilibrium moisture content. A fluidized bed dense medium separator is being developed which achieves cleaning efficiencies comparable with a Baum Jig. 12 refs., 5 figs., 9 tabs.

### 0104 Processing

*REFER ALSO TO CITATION(S) 7220, 7221, 7249, 7256, 8563*

**7195 (ARC—1988) Coal and hydrocarbon processing.** (Alberta Research Council, Edmonton (Canada)). [1988]. 8p. (CE—02024). Alberta Research Council, Editing and Publications Sales Dept., 5th. Floor, Terrace Plaza, 4445 Calgary Trail South, Edmonton, Alta., Canada T6H 5R7; $N/C.

Research facilities and programs for coal and hydrocarbon processing at the Alberta Research Countil are outlined. These facilities include laboratories, bench pilot plants, and analytical and process equipment. Services inlcude information dissemination, cooperation with industry, contract research, and testing. Specific areas of investigation in coal utilization research are: selective agglomeration processes for beneficiation of bituminous and sub-bituminous coal; combustion and gasification studies to help industry evaluate and adapt existing technologies to Alberta coals; and coprocessing and liquefaction processes. In the field of hydrocarbon upgrading, research is being conducted into primary upgrading of coal, heavy oils, bitumen, or residues; secondary upgrading of liquid products derived from bitumen or coal/bitumen coprocessing; development and evaluation of catalysts; and development of catalyst systems for the direct economical conversion of methane to more valuable hydrocarbon products. 20 figs.

**7196 (ARC—YCPY-4) Laboratory scale flash pyrolysis of Alberta subbituminous coals.** Knill, K.J. (Alberta Research Council, Edmonton (Canada)). Oct 1982. 24p. (CE—01959). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A laboratory scale flash pyrolyser was designed to determine the liquid and gas yields from coal pyrolysis at atmospheric pressure, residence times of 0.4 and 2.0 sec. and reaction temperatures from 550-800/sup 0/C. The pyrolyser would provide a basis for the determination of optimum process conditions to maximize light oil yields on the bench scale hydropyrolser. The apparatus pyrolyses coal at 1-8 g/h in an upflow, stainless steel tube reactor and separates the product into char, tar, water and gases. The product yield of the char, tar and water is determined gravimetrically and the gas product is characterized by gas chromatography. Highvale coal has been tested at reaction temperatures from 550-800/sup 0/C and 0.4 sec. residence time. Total conversion time increases from at 32% at 550/sup 0/C to 47% at 800/sup 0/C on an "as receievd" coal basis. The maximum tar yield is 12% by weight of the "as received" coal between 650 and 700/sup 0/C. 9 figs., 1 tab.

**7197 (ARC/TEE—REF-TEE-74) Coal liquefaction: materials and energy balances and a description of two-stage processes.** (Department of Fisheries and Oceans, Halifax, Nova Scotia (Canada). Fisheries Development Branch). Sep 1983. 19p. (CE—01963). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From one short ton of a typical bituminous coal, the maximum theoretical yield of a heavy fuel oil is 5.38 bbl and 25,643 standard ft/sup 3/ of hydrogen are required. The corresponding figures for a typical sub-bituminous coal are 5.08 bbl and 26,022 standard ft/sup 3/ of hydrogen. These yields are not achieved due to the following reasons: the production of gaseous products; char production and the use of char as a hydrogen source; and the incomplete conversion of coal. Under these circumstances, this report

shows that the typical liquid yields are 2.5-3.0 bbl per short ton of coal. The report describes how two-stage coal liqufaction processes have attempted to reduce the gaseous and char production and thereby increase the liquid yield. Since most of these processes are still at an experimental stage, the yield data is sketchy and cost data has not been reported. The report concludes that although the two-stage processes are a step in the right direction, it is to early to determine whether their product is cheaper and better. 25 refs., 6 figs., 4 tabs.

7198 **(DOE/LC/10884—2611) Multi-channel forward combustion in coal of variable degree of devolatilization: Final report.** Corlett. R.C. (Washington Univ., Seattle (USA). Dept. of Mechanical Engineering). May 1987. Contract AS21-82LC10884. 44p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88010273/JAW.

A research program has been carried out to facilitate incorporation of rubble formation and burnout phenomena in mathematical modeling of the production stage of underground coal gasification (UCG). Forward combustion in single channels in coal has been investigated by a computer model. The state of the coal ranges from virgin coal to completely charred coal. Usefully rapid regression of a UCG cavity wall is brought about by a sequence of roof or sidewall collapses. An extensive theoretical analysis of collapse mechanisms has been performed. Failure mechanisms include failure due to strength loss, formation of cracks which intersect bedding planes, and moisture induced stresses. These competing mechanisms are unified in a comprehensive model. 3 figs.

7199 **(DOE/MC/21063—2600) A 32-month gasifier mechanistic study and downstream unit process development program for the Pressurized Ash-Agglomerating Fluidized Bed Gasification System: Quarterly progress report, January 1--March 31, 1986.** (KRW Energy Systems, Inc., Madison, PA (USA)). Apr 1986. Contract AC21-84MC21063. 186p. NTIS, PC A09/MF A01 - OSTI. Order Number DE88010262/JAW.

The scope of work under this contract consists, in part, of design and installation of an external hot gas cleanup system for testing in the Process Development Unit (PDU) at Waltz Mill, PA. The design report was finalized and released this quarter, and construction work continued to complete installation of the external fixed-bed desulfurizer of zinc ferrite sorbent, the associated hot piping, and instrumentation. The upstream tertiary particulate removal system (a sintered metal filter) was successfully commissioned during PDU test TP-036-4. The post-test inspection results are included herein. This report also discusses the process followed in selection of a zinc ferrite sorbent for PDU testing and defines the hot gas cleanup Test Program Scope for 1986.

7200 **(DOE/PC/79866—T2) Proof-of-Concept testing of the HLC [Heavy Liquid Cyclone] technology: Quarterly report.** (Process Technology, Inc., Calumet, MI (USA); Bateman Engineers, Inc. (USA); Norton, Hambleton Engineering, Inc., Ann Arbor, MI (USA); American Electric Power Service Corp., New York; Michigan Technological Univ., Houghton (USA)). 19 Sep 1988. Contract AC22-87PC79866. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88017314/JAW.

During this period of 1988, Phase 2 of the Heavy Liquid Cyclone Proof-of-Concept testing was conducted and Phase 3 of the project got underway.

7201 **(DOE/PC/79912—4) Thiophene metabolism by E. coli.** Clark, D.P. (Southern Illinois Univ., Carbondale (USA). Dept. of Microbiology). [1988]. Contract FG22-87PC79912. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002729/JAW.

The objective of this project is to investigate the mechanism of thiophene and furan degradation by E. coli and to characterize the genes involved and the enzyme activities of their products. 4 tabs.

7202 **(DOE/PC/79936—3) Low severity conversion of activated coal: Quarterly report No. 3 for the period March 1, 1988--May 31, 1988.** Hirschon, A.S.; Ross, D.S.; Ackerman, L. (SRI International, Menlo Park, CA (USA)). Jul 1988. Contract AC22-87PC79936. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003310/JAW.

The objectives of this project are to: (1) develop an understanding of hydrothermal pretreatment chemistry and its optimization at temperatures and pressures no greater than 250{degree}C and 1000 psi, (2) develop a series of highly reactive and dispersible promoters of bond hydrogenolysis operating at temperatures no greater than 300{degree}C, and (3) successfully combine the pretreatment and hydrotreating steps to obtain high yields of toluene soluble coal products. The program is divided into four tasks, the first of which, Task 1, was the project work plan. Our experimental work during this quarter for Tasks 2 and 3 is summarized. 15 refs., 1 fig., 1 tab.

7203 **(DOE/PC/80023—T15) Development of an in-situ hydrogen measuring instrument for coal liquefaction processes: Quarterly report, July--September 1988.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract AC22-85PC80023. 21p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002306/JAW.

During this quarter, more tests were performed to determine the effect of ethane or methane on the hydrogen mass transfer rate on tetralin. The calculated method of hydrogen mass transfer coefficient used before was only based on the binary system, i.e., hydrogen and tetralin, but neglected the effect of methane or ethane. Since the third component might play an important role on the hydrogen mass transfer, a mathematically description of ternary diffusion was used to calculate the mass transfer coefficients, $k_{11}$, $k_{12}$, $k_{21}$, and $k_{22}$. The subscript "1" stands for hydrogen and "2" stands for methane or ethane. 9 figs.

7204 **(DOE/PC/80907—T10) Reactivity of coal in direct hydrogenation processes: Progress report, March 1988--May 1988.** Baldwin, R.M.; Miller, R.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 1988. Contract FG22-85PC80907. 47p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003338/JAW.

Liquefaction reactivity measurements have been carried out for a suite of 9 high-volatile bituminous coals from the US. Conversion profiles were measured for the 9 coals in a tubing-bomb microautoclave reactor, under a hydrogen blanket (900 psi initial pressure) with 1-methylnaphthalene as the vehicle. Reactivity measurements were carried out at 425{degree}C, and at reaction times of 3, 5, 10, 20, and 40 minutes. Conversions to THF, toluene, and hexane solubles were determined for each set of reaction conditions. Kinetic modeling of the reactivity data demonstrated that a first-order irreversible model was adequate to describe the the relative reactivities of the coals. Correlations of reactivity as defined by the first-order rate constant for formation of toluene solubles were found with oxygen and carbon contents of the coal. Hexane solubles rate constant was found to be correlated with total sulfur and pyritic sulfur in the parent coals. A two-parameter correlation for the toluene solubles rate constant was found with organic sulfur and atomic oxygen-to-carbon. Ancillary studies determined that the catalysis by the walls of the reactor and particle size effects were negligible for these data. 23 refs., 21 figs., 9 tabs.

7205 **(DOE/PC/90909—T8) Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, May 1988--July 1988.** Miller, R.L.; Baldwin, R.M. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 1988. Contract FG22-86PC90909. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002305/JAW.

Work continued to evaluate potential methods for reducing nitrogen adduction and thermal degradation during low severity coal liquefaction. By employing two fractional factorial experimental designs, the statistical effects of reaction severity, coal rank, solvent type (petroleum- or coal-derived), nitrogen compound promo-

tor (1,2,3,4-tetrahydroquinoline (THQ) or dipropylamine), heterogeneous catalyst addition, and $H_2S$ addition on single-stage process performance were determined. In addition to the extent of nitrogen adduction, THF soluble coal conversion, $C_4$-454{degree}C distillate yield, 454{degree}C+ THF soluble residuum yield, hydrogen consumption, and model nitrogen compound recovery were used as measures of process performance. Distillate and residuum yield results and nitrogen adduction data are discussed in this report. 8 refs., 10 tabs.

7206 **(DOE/PC/91257—T4) MCL (Gravimelt) system integration project: Quarterly report, July--September 1988.** (TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.). 1988. Contract AC22-86PC91257. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003305/JAW.

The objective of this project is to construct and operate an integrated test circuit for the Molten-Caustic-Leaching (Gravimelt) process for desulfurization and demineralization of coal to prove process economics assumptions, deliver product coal and to test process conditions aimed at significantly lowering costs. The integrated test circuit facility contains more than 160 pieces of equipment including filters, centrifuges, tanks, reactors, feeders and the equipment including filter, centrifuges, tanks, reactors, feeders and the kiln and rising film evaporator. The test circuit consists of six unit operations which together provide a continuous system for leaching coal and regenerating the reactant. These units are (1) a kiln for reacting molten caustic with coal, (2) a seven stage water washing section for recovering caustic from the coal, (3), a three-stage acid washing section for removing the last traces of metals and alkali and providing an ultra pure coal product, (4) a water treatment section to provide either dischargable or recycleable water, (5) a regeneration section to provide purified aqueous caustic and (6) an evaporator section to provide molten-caustic for recycle to the kiln reactor. 3 tabs.

7207 (EUR—11191, pp 339-381) **Catalysis in direct coal liquefaction.** Charcosset, H.; Genard, A. (Institut de Recherche sur la Catalyse, Villeurbanne (France)). 1987.

In Synthetic fuels from coal: status of the technology.

Part 5 of the report is a review on coal hydrogenation catalysis. In direct coal liquefaction the efficient transfer and distribution of hydrogen is an important parameter and can be achieved by the use of selective catalysts. Many investigations of available catalysts for the production of synthetic fuels from coal have been carried out. This review covers the literature on catalysis, in single stage and two-stage coal liquefaction, in coprocessing and in the upgrading of coal derived products. Fundamental studies on mechanisms are also discussed.

7208 **(EUR—11191) Synthetic fuels from coal: status of the technology.** Romey, I.; Paul, P.F.M.; Imarisio, G. (eds.). (Commission of the European Communities, Brussels (Belgium)). 1987. 387p. Commission of the European Communities, Brussels, Belgium.

This substantial report is a critical review of the state of the art of the technology of synthetic fuels from coals. It contains five parts and the topics covered are: indirect liquefaction; single stage direct coal liquefaction; direct liquefaction (two-stage process); coprocessing (coprocessing with oil); catalysis in direct coal liquefaction. Individual parts are abstracted separately

7209 **(PB—88-250287/XAB) Clean coal technology: an environmental perspective.** Princiotta, F.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 28p. (EPA—600/D-88/190). NTIS, PC A03/MF A01.

Although this paper focuses on past (since 1920) and current coal use and pollutant emissions in the U.S., it also discusses where the U.S. may be going in terms of pollutant emissions over the next several decades. Conclusions of this look at coal use include the fact that increasing coal use is vital to the economic wellbeing of the U.S. With proper application of controls, coal use can be increased as projected without unacceptable levels of sulfur and nitrogen oxides, particulate, and nitrous oxide. However, the forecast is bleaker for carbon dioxide and its projected impact on global warming. Barring a technology breakthrough of major proportions (e.g., successful commercialization of nuclear fusion or solar electric generation), the best that can be envisioned is to moderate carbon dioxide emissions from the combustion of coal and other fuels through conservation.

7210 **(PB—89-102370/XAB) Preliminary air-quality assessment of the BG and E/IGCC (Baltimore Gas and Electric/Integrated Coal Gasification Combined Cycle) plant at Perryman. Final report.** Corio, L. (Versar, Inc., Columbia, MD (USA)). Jun 1988. 34p. NTIS, PC A03/MF A01.

Preliminary flat and rough-terrain air-quality modeling of stack emissions was performed for Baltimore Gas and Electric's (BG&E's) proposed Perryman coal-gasification plant using five years (1982-1986) of representative meteorological data from Baltimore-Washington International airport. Results from the air-quality analysis showed that Perryman will not cause or contribute to any exceedances of the NAAQS (when combined with model-predicted impacts from BG&E's Crane power plant, the Harford County resource-recovery facility, and the Pulaski highway incinerator) or the allowable PSD increments. Results also show that, of the local sources examined, the Crane power plant is a major contributor to the impacts in the area near Perryman.

7211 **(PB—89-102834/XAB) UCG (underground coal gasification) contaminant control program: simulation of post-burn UCG contaminant production. Final report, October 1986-September 1987.** Boysen, J.E.; Mones, C.G.; Covell, J.M.; Sullivan, S.; Glaser, R.R. (Western Research Inst., Laramie, WY (USA)). Mar 1988. 131p. NTIS, PC A07/MF A01.

This report presents the results of laboratory and modeling research directed towards minimizing the adverse impact of UCG on local ground-water quality. The Clean Cavern Concept was investigated using laboratory reactor simulations. Operating recommendations for UCG field testing were made based upon the results of the laboratory and numerical analyses of the simulations. The results of the research indicate that the adverse impact of UCG on local ground-water quality can be substantially reduced by following simple low-cost operating procedures when gasification of the coal has ended and by minimizing gas lost during gasification. Steam flushing of the hot UCG cavity immediately after gasification and sustained venting of the UCG cavity as it cools are the operating procedures recommended.

7212 **(PB—89-103899/XAB) Underground coal-gasification contaminant-control program: laboratory analysis of samples from the TONO I UCG cavity - materials characterization and environmental implications. Topical report, November 1986-June 1987.** Oliver, R.L.; Mason, G.M. (Western Research Inst., Laramie, WY (USA)). Jun 1987. 37p. NTIS, PC A03/MF A01.

The major issue addressed in the report is the relationship between cavity-material characteristics and ground-water impacts. Samples from the Tono excavation cavity were characterized by various analytical methods. Results indicate the unaltered coal mineralogy consisted of quartz, clay minerals, and feldspars, with some calcite, pyrite, gypsum, and zeolite. Of the altered material, char exhibited a similar mineralogy with a slight increase in gypsum, a loss of pyrite, and the appearance of some higher-temperature minerals. Data suggest that most ground-water contamination generated by leaching in a UCG cavity will be derived from char and the altered clay, carbonate, and sulfurous minerals contained within the char.

7213 **(PB—89-109219/XAB) Industry-wide studies report of Westinghouse Coal Gasification PDU (process developing unit), Madison, Pennsylvania on October 31, 1975. Trip report.** Young, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Field Studies and Clinical Investigations). 10 Dec 1976. 127p. (IWS—059.12). NTIS, PC A07/MF A01.

An on-site visit was made to a 15-ton/day process developing unit (PDU) which produces a hot, low-Btu fuel gas for power generation using a combined-cycle power-generating facility. At

the facility, coal and dolomite were crushed, sized, and dried prior to being fed to the gasification system. Hot fuel gases were cleaned of particulates and combusted with air; the gases were expanded through a gas turbine to produce electricity. Exhaust gases from the turbine generate steam in a heat-recovery steam generator. The following attachments were included to define the safety and health program in place at the facility: emergency plan, safety procedures, safety training procedures, operating procedure for a nuclear radiation gauge, noise survey, utilities building, coal tar health hazards, monitoring of air quality, protective clothing, and radiation work permit. The author concludes that the industrial-hygiene characterization program for coal gasification should be conducted at the pilot facility level, if possible.

7214 **(PB—89-109722/XAB) Cool Water Coal Gasification Program Monitoring Review Committee Meeting Report, December 2-3, 1987.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). Dec 1987. 222p. NTIS, PC A10/MF A01.

See also PB—89-109748.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. The Program agreed to comply with existing environmental monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. Results of the fifth meeting held Dec 2 & 3, 1987 are presented.

7215 **(PB—89-109730/XAB) Cool Water Coal Gasification Program environmental monitoring plan. 1986 Indicator phase. Volume 1. Technical report.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 18 Mar 1988. 1212p. NTIS, PC A99/MF E08.

Also pub. as Radian Corp., Austin, TX. rept. no. DCN-88-218-042-89. See also PB—89-109722 and PB—88-156344.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. The Program agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evalating plant operations and for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. Reduced Screening Phase monitoring is designed to extend the data base to cover different coal feeds and/or operating conditions. In operation of the quench gasifier using Program coal (SUFCO), the quench gasifier has a lower capacity than the main gasifier.

7216 **(PB—89-109748/XAB) Cool Water Coal Gasification Program environmental monitoring plan. Quench reduced screening phase. Volume 1. Technical report.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 12 May 1988. 525p. NTIS, PC A22/MF A01.

Also pub. as Radian Corp., Austin, TX. rept. no. DCN-88-218-042-92. See also PB—89-109730.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Cool Water Coal Gasification Program is one of the four projects awarded financial assistance. The Program agreed to comply with existing environmental monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socio-economic impacts during the period 1984-1989. As the first commercial-scale integrated gasification combined-cycle plant for generating energy from coal, the plant is designed to process a variety of coals with no liquid discharge, produce non-hazardous solid wastes, and produce very few air emissions. Monitoring data are to provide an information base for evaluating plant operations for establishing information on environmental uncertainties associated with replication of synthetic-fuels facilities. The second annual report contains results of continuous and periodic monitoring of plant performance, using Program coal (SUFCO), conducted during 1986.

7217 **(PB—89-114763/XAB) Radical intermediates and their subsequent reaction pathways in salt-catalyzed coal gasification. Final report, January 1985-January 1988.** White, S.H.; Twardoch, U.M. (EIC Labs., Inc., Norwood, MA (USA)). Sep 1988. 147p. (C—811). NTIS, PC A07/MF A01.

See also PB—86-215670.

The purpose of the study has been to seek evidence for the occurrence of both anodic and cathodic radical forming processes in catalytically inert metal chloride containing solvents using model arene compounds with and without additions of catalysts such as alkali carbonates and bicarbonates at temperatures in excess of ambient. Spectroscopic studies of perylene in the ternary zinc chloride-alkali metal chloride mixture demonstrate the stability of the arene to temperatures in excess of 400°C, although the vapor pressure is considerably higher than expected from literature data. The results of these studies show that the treatment of the melts with hydrogen chloride does not lead to significant residual HCl in the melt with the resultant formation of perylinium ions. Electrochemical studies have shown that arenes undergo redox reactions in the alkali metal chloride and zinc chloride based melts. The oxidative reaction of perylene in melts of low nucleophilicity leads to polymerization. In the case of the vitreous-carbon surface, polymeric films are formed and are chlorinated at high anodic potentials to produce another polymeric film with quite different electrochemical characteristics.

7218 **(PB—89-114771/XAB) Evaluation of catalytic systems for hydrogasification of coal. Final report, October 1986-April 1988.** Lilga, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. 82p. NTIS, PC A05/MF A01.

A literature search was conducted and a coal-char-reactivity data base was constructed. Reactivities relative to the demineralized chars clearly show: (1) decreased lignite reactivity upon demineralization, (2) increased reactivity of high-rank-coal chars upon demineralization, and (3) the ex t of enhancement by added catalysts of the gasification reactio Demineralized chars of all ranks show similar reactivity in $O_2$, $H_2O$, $CO_2$, and $H_2$. Gasification rates relative to $CO_2$ are about the same for all char ranks including chars that were demineralized or raw and those with added catalysts. Average relative rates for $O_2$, $H_2O$, $CO_2$, and $H_2$ gasification are 1 x 10(4), 6.2, 1, and 8.5 x 10(-2), respectively. The result can be explained if the distribution of active sites reactive with each gas is the same in all char types. The magnitude of the rate is governed by the number of active sites for each gas from char to char, and the function of the catalyst is to create new active sites by promoting gas dissociation at the metal surface. Catalyzed char reactivities could be predicted for previously demineralized coals or for $CO_2$ gasification of raw coal chars.

7219 **(PB—89-126205/XAB) Evaluation of coal-conversion catalysts. Final report, January 1978-December 1985.** Lee, A.L. (Institute of Gas Technology, Chicago, IL (USA)). Nov 1987. 82p. NTIS, PC A05/MF A01.

See also PB—86-157437.

A novel family of sulfur-resistant, low-carbon fouling hydrogenation catalysts were discovered by Catalysis Research Corporation for GRI. These catalysts promote the direct methanation reaction in which equal molar concentrations of $H_2$ and CO react to produce $CH_4$ and $CO_2$. IGT evaluated these catalysts. The work

performed during the period included the following: Evaluated 12 sulfur-resistant catalysts for direct methanation; Obtained design data for the direct methanation process for British Gas Corp./Lurgi Slagging, Lurgi, Westinghouse, Underground Coal, and Shell gasification processes; and Performed life tests of 200 to 10,000 hours.

## 0105 By-products

*REFER ALSO TO CITATION(S) 7373, 7714*

7220 **(AD-A—198700/7/XAB) Production of jet fuels from coal-derived liquids. Volume 4. GPGP jet-fuels production program-feed analyses compilation and review. Interim report, October 1987-January 1988.** Rossi, R.J. (Burns and Roe Services Corp., Pittsburgh, PA (USA)). Jul 1988. 129p. NTIS, PC A07/MF A01.

See also Volume 5, AD-A198 701.

In September 1986, the Fuels Branch of the Aero Propulsion Laboratory at Wright-Patterson Air Force Base, Ohio, began an investigation of the potential of jet-fuel production from the liquid by-product streams produced by the gasification of lignite at the Great Plains Gasification Plant (GPGP) in Beulah, North Dakota. Funding was provided to the Department of Energy (DOE) Pittsburgh Energy Technology Center (PETC) to administer the experimental portion of this effort. This document reports the results of the effort by Burns and Roe Services Corporation/Science Applications International Corporation (BRSC/SAIC) to compile and review physical and chemical characterization data for the GPGP by-product liquids. This report describes the relative reliability of the various characterization data and indicates where specific limitations exist.

7221 **(AD-A—198701/5/XAB) Production of jet fuels from coal-derived liquids. Volume 5. Recovery of benzene/benzene plus phenol from the Great Pplains Gasification Plant crude phenol stream. Interim report, September 1987-February 1988.** Harris, E.C. (Burns and Roe Services Corp., Pittsburgh, PA (USA)). May 1988. 107p. NTIS, PC A06/MF A01.

See also Volume 4, AD-A198 700.

In September 1986, the Fuels Branch of the Aero Propulsion Laboratory at Wright-Patterson Air Force Base, Ohio, began an investigation of the potential for production of jet fuels from the liquid by-product streams produced by the gasification of lignite at the Great Plains Gasification Plant located in Buelah, North Dakota. Funding was provided to the U.S. Department of Energy (DOE) Pittsburgh Energy Technology Center (PETC) to administer the experimental portion of this effort. This report details the program with Hydrocarbon Research, Inc., a subcontractor to Burns and Roe Services Corporation, who, as a subcontractor to DOE, investigated the potential of producing benzene or benzene plus phenol from the crude phenol stream.

7222 **(EPRI-CS—5981-Vol.2) Fly ash construction manual for road and site applications: Volume 2, Contractor's guide: Final report.** Glogowski, P.E.; Kelly, J.M.; Curry, M.A. (Electric Power Research Inst., Palo Alto, CA (USA); GAI Consultants, Inc., Monroeville, PA (USA)). Oct 1988. 134p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89002493/JAW.

This two-volume manual presents information for the specification writer or contractor planning to use coal fly ash in the following applications: Fills, Embankments, and Backfills; Subgrade Stabilization; Pavement Base Course; Slurry Backfill; Soil Amendment. This document, Volume 2, "Contractor's Guide," contains information directed toward contractors that describes equipment selection criteria and proper construction techniques. Sample specifications are included as appendices to each volume. 29 refs., 23 figs., 1 tab.

## 0106 Properties

*REFER ALSO TO CITATION(S) 7278*

7223 **(CONF-880912—19) Characterization of the Argonne premium coal samples by pyrolysis high resolution mass spectrometry.** Winans, R.E.; McBeth, R.L.; Neill, P.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003938/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

The complete set of Argonne Premium Coal Samples have been characterized using Pyrolysis High Resolution Mass Spectrometry (PyHRMS). A major objective in the study is to examine differences in the heteroatom (oxygen, sulfur and nitrogen) containing molecules as a function of rank of the coals. Operating in the high resolution mode makes it possible to directly separate these species from each other and from the hydrocarbon molecules. In addition, many molecules, which can not be observed with gas chromatography by virtue of their size or polarity, can be observed with this method. 12 refs., 7 figs., 1 tab.

7224 **(CONF-8809162—2) Analytical characterization of coal surfaces and interfaces.** Fuller, E.L. Jr. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003127/JAW.

From Advanced Research and Technology Development (AR&TD) direct utilization, instrumentation, and diagnostics contractors review meeting; Pittsburgh, PA, USA (6 Sep 1988).

Oxidation of coals is of concern to those interested in the weathering that begins as soon as the mined material is wrested from the humid, reducing, pressurized environment of the underground seam. The loss of energy content comprises an obvious economic impact to combustion processes. Flocculation and coking processes are both deleteriously affected. Information regarding the structure and reaction mechanisms can be obtained by detailed analysis of oxidation. This work is directed primarily to defining the surface structures and mechanisms occurring at the air/coal interface. 10 refs., 8 figs.

7225 **(DOE/PC/70804—T5) Computer modeling of the rheology of particulate suspensions.** Hafaiedh, A. (Alfred Univ., NY (USA)). Jul 1988. Contract FG22-84PC70804. 189p. NTIS, PC A09/MF A01. Order Number DE88016844/JAW.

A computer model has been developed to simulate two dimensional flow and to predict the rheological properties of particulate suspensions. The model uses a three dimensional box with an upper wall which moves at a constant velocity, a bottom stationary wall, and left and right periodic boundaries. The centers of the particles move in two dimensions along the center plane of this box. The shear rate which can be varied is the ratio of the velocity of the upper wall to the height of the box. The shear stress required to keep the upper wall moving at the constant velocity is calculated and used to calculate system properties such as the suspension viscosity. This model uses a molecular dynamics approach where the particle paths are followed exactly. Both particles in a vacuum and particles in a liquid were investigated. The simulations performed dealt with the effects of controllable suspension characteristics, such as solids content, particle size distribution, and coefficients of friction, on the viscosity-shear rate dependence and on the velocity profiles. The calculated rheological properties of the suspensions show very good agreement with published experimental results. 54 refs., 32 figs., 3 tabs.

7226 **(DOE/PC/79905—T3) Fundamental research on surface science of coal in support of physical beneficiation of coal: Quarterly report No. 3, April 1--June 30, 1988.** Good, R.J. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). 1988. Contract AC22-87PC79905. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004414/JAW.

A research grade microscope and two glove boxes for oxygen-free operations have been acquired. Contact angle measurements on Kentucky No. 9 coal have been consistent with those made in the previous quarter, with oil/water contact angles in the range of 35 to 38{degree} measured through the oil, for coal, and about 80{degree} for iron pyrite. Adsorption measurements on Upper Freeport coal with 0.2% octanol in decane reveal that at this concentration, the octanol adsorbs only on the external surface and covers more than half of a monolayer area. These adsorption measurements will be used to correlate with the contact angle measurements. Scanning electron microscopy was used in identifying the highly reflective inclusions in coal, as pyrite and the thin white sections as calcium carbonate. 1 fig., 1 tab.

7227 **(DOE/PC/79907—T3) Spectroscopic study of coal structure and reactivity: Annual report.** Griffiths, P.R. (California Univ., Riverside (USA). Dept. of Chemistry). [1988]. Contract FG22-87PC79907. 25p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002161/JAW.

The purpose of this project is the development of numerical methods for the quantitative analysis of coals by Fourier transform infrared (FT-IR) spectrometry. The infrared spectra of coal and coal extracts consist of complex bands containing many closely overlapped peaks, and resolution enhancement techniques must be used if quantitative data are to be obtained. During the first year of this project, three major areas have been covered: (1) the effect of optical geometry on the diffuse reflectance infrared spectra of coals; (2) the development of numerical methods for resolution enhancement and quantitative measurements of complex spectra; and (3) the effect of rank and particle size on the rate of air oxidation of bituminous coals. The first sub-project, concerning the effect of optical geometry on the diffuse reflectance infrared spectra of coals has been completed. 17 refs., 9 figs., 4 tabs.

7228 **(DOE/PC/79914—T3) Macromolecular coal structure as revealed by novel diffusion tests: Annual technical report, September 15, 1987--September 14, 1988.** Peppas, N.A. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1988. Contract FG22-87PC79914. 36p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003094/JAW.

During this funding period the design and building of the new interferometer/polariscope for the determination of penetrant concentration and stress profiles in coal samples was completed. This equipment is used for measurement of stresses in the coal samples. Various thin coal sections have been prepared and have been tested for penetrant transport. 19 refs., 13 figs., 1 tab.

7229 **(DOE/PC/80529—T9) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 12 for the period 1 July 1988--30 September 1988.** Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Oct 1988. Contract FG22-85PC80529. 23p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89001987/JAW.

This report summarizes technical progress made during the twelfth quarterly reporting period for a study being conducted for the US Department of Energy's Pittsburgh Energy Transfer Technology Center. This quarterly period extended from 1 July 1988 to 30 September 1988. Pore size distributions were measured for the virgin coals and the extracted chars. Nitrogen BET and carbon dioxide DP surface area measurements were made for the extracted chars. The secondary gas heating system of the reactor was tested. The heating system uses an inductively coupled plasma flame to heat argon gas, which is then mixed with the secondary gas. A feasible configuration for the torch enclosure and the remote control unit was determined. Plans are also presented for the following quarterly period. 29 figs., 2 tabs.

7230 **(DOE/PC/90519—T7) Electrochemical characterization and derivation of coal: Technical progress report, September 15, 1987--September 14, 1988.** Park, S.M. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90519. 19p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002724/JAW.

In this second year of the project the following studies were carried out: effects of catalysts on the extraction of humic acids, electrochemical oxidation of humic acids, total analysis of coal samples that will be used for coal liquefaction studies, and theoretical studies on electrochemical processes related to the oxidation or reduction of coal slurries. The oxidation of humic acids was studied for two purposes: (1) as a preliminary study for coal/humic acids derivatization, and (2) as a model for understanding the oxidation of coal. Results indicate that a large fraction of hydroxide groups on humic acids is oxidized to produce hydrocarbons as a product. Since it is expected that extensive studies on the electrochemical hydrogenation of coal/humic acids will be run it was decided to perform a total analysis on some of New Mexico coal samples. The results are described in this report, and it will provide a basis for using a certain coal sample for the studies that will follow. The electrolytic oxidation of coal slurries in acidic medium was shown to follow a catalytic mechanism. While it was not explicitly shown in a later report, the oxidation of coal slurries in phosphoric acid seems to follow a catlaytic-deactivation mechanism.

7231 **(EUR—11000) Certification of the ash content and of the gross calorific value of three coals: gas coal CRM no.180, coking coal CRM no.181, steam coal CRM no.182.** Anon. (Commission of the European Communities, Luxembourg). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756034/JAW.

This report describes the additional certification of the ash content and of the gross calorific value of coal in three coal reference materials which were previously certified for their contents (mass fraction) of Carbon, Hydrogen, Nitrogen, Chlorine, Arsenic, Cadmium, Manganese, Mercury, Lead, Selenium, Vanadium and Zinc. For coals 180-182 the certified values for the gross calorific value are respectively 31.89, 35.43 and 29.68 Mj/kg; whereas for the ash content the following values were obtained: 99.0, 18.5 and 122.7 g/kg.

7232 **(IEACR—12) Coal classification.** Carpenter, A.M. (IEA Coal Research, London (UK)). Oct 1988. 104p. IEA Coal Research, London, United Kingdom.

Literature (mainly post 1980) on coal classification is reviewed. Over the years many classification systems have been proposed for coal. Some of the classification systems currently in use in the member countries of IEA Coal Research are examined. These include Seyler's chart, the ASTM (used in North America), NCB (UK), Australian (including the new 1987 system), German (Ruhr) and international (for both hard and soft coal) classifications. The new international codification system is also covered. Reasons for the poor fit of some coals are discussed. The properties of coal (chemical, physical, mechanical and petrographic) that are used as classification parameters, and their determination, are described. A short section is included on potential analytical techniques. Properties of relevance in combustion, liquefaction and coking of coal and their use, or potential use, as classification parameters are then examined. 387 refs.

7233 **(IS—4952) Development of instrumental techniques for coal surface analysis: Functional group analysis in coal by $^{31}P$ NMR spectroscopy: Quarterly report, October 1, 1987--December 31, 1987.** Verkade, J.G. (Ames Lab., IA (USA)). Feb 1988. Contract W-7405-ENG-82. 12p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003748/JAW.

The primary aim of our research is to develop a convenient, sensitive, reliable and rapid technique for the qualitative and quantitative analysis of -COOH, -OH, -NH and -SH functionalities in coal, on coal surfaces and in coal-derived materials such as condensates and extracts. To achieve our objective, we will be exploring the use of Fourier transform $^{31}P$ nuclear magnetic resonance spectroscopy, which has in recent years become a routine method for the measurement of both liquid and solid materials. In order to apply this technique most efficiently to the qualitative and quantitative analysis of functional groups in coal materials, it was necessary to survey the literature for suitable reagents and for previous analytical efforts involving the NMR spectroscopy of derivatized functional groups. What follows is a summary of our search. 19 refs., 2 tabs.

7234 **(IS—4973) Microcharacterization of coal components for beneficiation: Quarterly report, April 1, 1988--June 30, 1988.** Straszheim, W.E.; Markuszewski, R.; Younkin, K.A. (Ames Lab., IA (USA)). Aug 1988. Contract W-7405-ENG-82. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003765/JAW.

The goal of this research is to develop and apply SEM-based automated image analysis techniques for the characterization of mineral matter, and especially pyrite, in coal in order to aid the development of new coal beneficiation processes. Particular emphasis is given to quantifying the type and extent of association of mineral particles with the coal as an indication of cleanability. A further goal is to use AIA results to predict the improvement in cleanability as a function of further size reduction, in order to achieve better liberation. X-ray spectra of hematite, siderite, pyrite and iron sulfate are presented. 10 refs., 4 figs.

7235 **(PB—89-102800/XAB) Electron transfer and radical-cation reactions of model coal compounds. Final report, April 1, 1985-April 30, 1988.** Camaioni, D.M. (Pacific Northwest Lab., Richland, WA (USA)). 19 Aug 1988. 143p. NTIS, PC A07/MF A01.

See also PB—87-148763.

This report describes an investigation of the reactions of coal-related aryl-alkyl molecules by radical-cation pathways. Mechanisms of radical-cation reactions were elucidated from product studies of Cu(II)-peroxydisulfate oxidations, rate constants for electron transfer and radical cation reactions were determined from the kinetics of pyridine-promoted tris(phenanthroline)-iron(III) oxidations, and bond dissociation energies (BDE) and structures of radical cations were calculated by semi-empirical molecular orbital theory (AM1). Effects of media, aryl structure and alkyl structure on the reactions of radical cations, i.e., nucleophilic addition, deprotonation and side chain C-C bond scission, are discussed in light of stated findings.

7236 **(PB—89-115281/XAB) Characterization of coal macerals by high-resolution supercritical-fluid chromatography. Final report, May 1985-April 1988.** Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). Sep 1988. 94p. NTIS, PC A05/MF A01.

See also PB—87-218871.

Methods for the analysis of the macromolecular structure of coal were developed and evaluated. They included solvent extraction with pyridine, fractionation of the extract by column chromatography, and final separation and identification by capillary column gas and supercritical fluid chromatography. A multidimensional supercritical fluid chromatographic system was constructed and evaluated for further fractionation and separation of complex coal molecules. Six vitrinite-rich coals of differing rank were analyzed using the developed procedures. While there were basic structural similarities among all of the coal extracts, there were structural changes that could be correlated primarily with rank. Di- and triterpeniod compounds were present in significant concentrations in the low-rank coals, while they were nearly absent in the high-rank coals. In contrast, aromaticity increased in the high-rank coals, with a trend to larger, condensed-ring systems. Three of the coal residues left after solvent extraction were depolymerized by solvated electrons in a potassium-crown ether solution. This increased the solubilities of the coals to 12-60%, depending on their original oxygen contents.

7237 **(SRC—E-725-1-C-81) Determination of rheological properties of coal-oil slurries, final report.** Gillies, R. (Saskatchewan Research Council, Saskatoon (Canada)). Feb 1981. 102p. CANMET, 555 Booth St., Ottawa, Canada K1A OG1.

This project was undertaken in an effort to obtain experimental rheological data which could be used to design coal-oil mixture transfer lines for coal combustion and coal gasification plants. Data collected during tests with a bench-scale Brookfield viscosimeter and a vertical tube viscosimeter built by the Saskatchewan Research Council are presented. In an effort to obtain rheological data at elevated temperatures it was necessary to build a new variable temperature vertical tube viscosimeter. The design of the viscosimeter and mechanical problems experienced during its operation are discussed. 31 figs., 5 tabs.

7238 **Matrix isolation-Fourier transform infrared spectroscopy studies of flash pyrolysis of four coal tars.** Chu, C.J.; Hauge, R.H.; Margrave, J.L. (William Marsh Rice Univ., Houston, TX (USA)). *Journal of Analytical and Applied Pyrolysis;* **14**: No. 2-3, 99-114(Dec 1988).

Flash pyrolysis of tar molecules from four coals (Illinois No. 6, Pittsburgh bituminous, Rawhide sub-bituminous and Texas lignite) was studied using matrix isolation-Fourier transform infrared spectroscopy. Significant methyl radical formation was observed for the first time as a pyrolysis product of tar thus indicating that it plays an important role in methane formation. Primary products from tar decomposition at 1100 C were C/sub 2/H/sub 4/, CH/sub 4/, HCN, CS/sub 2/, CS and CH/sub 3/. The production of HCN is found to vary with organic nitrogen content. CS is shown to be an important sulfur-containing species at high temperature. Trace amounts of small unsaturated hydrocarbons such as benzene, propyne, 1-butyne, allene, propylene and acetylene were also observed. Weight loss measurements show that a major portion of the tar is deposited as a carbonaceous deposit within the pyrolysis reactor. 9 figs., 7 refs., 5 tabs.

7239 **Matrix isolation-Fourier transform infrared spectroscopy studies of slow pyrolysis processes for four coals.** Chu, C.J.; Cannon, S.A.; Hauge, R.H.; Margrave, J.L. (William Marsh Rice Univ., Houston, TX (USA)). *Journal of Analytical and Applied Pyrolysis;* **14**: No. 2-3, 115-134(Dec 1988).

Slow pyrolysis processes for four coals (Illinois No. 6, Pittsburgh bituminous, Rawhide sub-bituminous and Texas lignite) were studied using matrix isolation-Fourier transform infrared (FTIR) spectroscopy. The temperature-dependent evolution of products during slow pyrolysis was used to correlate product species to the existence of various functional groups initially present in the respective coals. As other investigators have found, the amount of a specific product is correlated to the initial amount of a specific functional group. The yields of pyrolysis products such as CO, CO/sub 2/, H/sub 2/O, H/sub 2/S, CS/sub 2/, HCN and CH/sub 4/ were derived from peak area calculations and their corresponding extinction coefficients. Correlations were established between the yields of low-temperature CO and the amount of ether functional groups in coal, between CO/sub 2/ and carboxyl functional groups in coal, between H/sub 2/O and hydroxyl functional groups, between HCN and organic nitrogen and between CS/sub 2/ and H/sub 2/S to sulfur. The extent of methane evolution correlates with existing methyl groups initially present in the respective coals. Pyrolysis and reduction of kaolinite in coal were observed at high temperatures (approx. 1150-1500 C) to form the high-temperature species SiO, Al/sub 2/O and aluminium atoms. Aluminium atoms were detected in the presence of CO, by the formation of Al-CO complexes to give Al/sub x/(CO)/sub 2/ and Al/sub x/CO. The intensities of these aluminium complexes give a qualitative measurement of the amount of kaolinite in coal. Results obtained from the slow pyrolyses of these four coals have demonstrated the potential of matrix isolation-FTIR spectroscopy as an useful analytical tool for the study of fossil fuels. 10 figs., 23 refs., 7 tabs.

7240 **Some comments on the peat to lignite transition.** Cohen, A.D. (Los Alamos National Laboratory, NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 550(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

BTU content, moisture content, carbon content, cellulose content, color, and reflectance have all been used to some degree in defining the boundary between peat and lignite; yet, most authors have been noticeably vague in their use of these parameters. Two reasons for this vagueness may be 1) the lack of comparable data on peats and lignites and 2) the overlapping of measured values between materials that are presently accepted as peats and those that are presently considered lignites. The ASTM Classification of Coals by Rank, for example, defines the lower limit of lignite at 6300 BTU/lb (MMMF); yet, naturally-occurring peats may have BTU values exceeding this value. Overlapping values have also been measured for carbon content, color, and even reflectance. Comparisons of these measurements may be further complicated by uncertainty as to which ingredients in peats are comparable to those in

lignites. Another complicating factor is that different peat constituents can change at different times during early stages of coalification. The transformation from peat to lignite is, thus, a somewhat erratic process in which ingredients are changing at different times and different rates depending on such factors as 1) original chemical composition, 2) water chemistry, and 3) biological processes, with variability in these factors being on a microenvironmental scale.

## 0108 Waste Management

*REFER ALSO TO CITATION(S) 7199, 7211, 7222, 7286, 7715, 8543, 8773, 8774, 8775, 8776, 9165*

7241 **(CRIE-T—86096) Transport of solutes from coal ash through soil (1st report). One-dimentional solute transport model.** Sato, Kazuo; Sakata, Masahiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755700/JAW.

To establish transport models that estimate movement of solutes leached from coal ash in soil, the soil-column experiment has been carried out under neutral condition, and the applications of transport models have been investigated. Constituents studied were $SO_4$-S, B, Mo, As(V), and Cr(VI), Cl was used as a tracer for soil seepage water. Infiltration velocity of the constituents through soil-colum was Cl>B>$SO_4$-S>Cr(VI)>Mo>As(V). As for the transport model on soil seepage water, the two-component convective-dispersive equation which assumed the existence of immobile water described well the experiment result. The Henry type equilibrium adsorption equatio described the adsorption of $SO_4$-S,B and Mo on soil, whereas the Freundlich type non equilibrium adsorption equation described the adsorption of As(V) on soil. As for the estimation of infiltration velocity of Cr(VI), it is necessary to consider reduction of (VI) to Cr(III) in addition to adsorption. (25 figs, 2 tabs, 18 refs)

7242 **(CRIE-T—87029) Effect of emissions from a coal-fired power plant on soil trace element concentrations.** Sato, Kazuo; Sada, Koichi; Asakura, Kazuo; Nishinomiya, Sakae. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 38p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88755707/JAW.

A coal-fired power plant that has been operated for 25 years was selected as a representative plant for this study. The effect of trace elements (As, Cd, Cr, Cu and Hg) in the flue gas emitted from the plant on the soil environment has been evaluated through the soil observations and diffusion estimation. The element concentrations in soil in the vicinity of the plant roughly coincided with those observed at background regions. The Enrichment Discrimination Factors (EDF) for the 5 elements were also within the range of those observed at background regions. The amount of elements deposited on the soil in the vicinity of the plant was estimated by diffusion estimation assuming that there were no carrying away by rain-fall. As a result, increases in EDF caused by deposition of elements for 25 years were estimated to be less than 0.2. This value was within the range of the scatter at background regions. From these results, it can be said that even for the power plant which has been operated for the longest period in Japan, the amount of trace elements deposited would not be detectable level and that the effect of emissions on the soil environment is negligible. (9 figs, 8 tabs)

7243 **(DOE/MC/22193—2582) Detailed studies of novel regenerable sorbents for high-temperature coal gas desulfurization: Final report.** Flytzani-Stephanopoulos, M.; Gavalas, G.R.; Jothimurugesan, K.; Lew, S.; Sharma, P.K.; Bagajewicz, M.J.; Patrick, V. (Massachusetts Inst. of Tech., Cambridge (USA)). Oct 1987. Contract FC21-85MC22193. 213p. NTIS, PC A10/MF A01 - OSTI. Order Number DE88001086/JAW.

The novel sorbent systems considered in this program are bulk mixed oxides of copper, aluminum and iron, as well as zinc and titanium oxide mixtures capable of removing $H_2S$ from a level of 0.5--1.0 mol % in coal-derived gases down to a few parts per million, ppM(v). The latter sorbents were examined up to 650{degree}C (1200{degree}F), which is the operating temperature of molten carbonate fuel cells (MCFC), primarily in regard to stabilization of ZnO against reductive metallation (and vaporization). Both types of sorbent systems also address another application, namely, Integrated Gasification Combined Cycle (IGCC) power generation where the hot coal gas (after removal of contaminants) is used to drive a gas turbine. The CuO-based sorbents are developed for an extended range of operating temperatures (up to 1500{degree}F). Objectives were to (1) examine reduction stabilization effects imparted on CuO and ZnO by additives such as $Al_2O_3$ and $TiO_2$, respectively; (2) prepare different sorbent compositions in porous granular form, and test them under similar conditions of sulfidation-regeneration in a lab-scale quartz reaction system; (3) evaluate and select most promising sorbents on the basis of performance stability, $H_2S$ removal efficiency, sulfur capacity, and regeneration characteristics; (4) prepare selected sorbents in the form of 1/8″ extrusions combining suitable pore structure and good mechanical strength; and (5) carry out cyclic sulfidation-regeneration tests with selected sorbent extrusions at 650{degree}C and examine the structural stability and performance regenerability of sorbents after extended use. 32 refs., 59 figs., 26 tabs.

7244 **(DOE/PC/91101—T7) Sulfur dioxide removal from flue gases by supported copper and iron absorbents: Technical report No. 7, February 16, 1988--May 15, 1988.** Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). 1988. Contract FG22-86PC91101. 7p. NTIS, PC A02 - OSTI. Order Number DE89003060/JAW.

Studies of the sorption of $SO_2$ from simulated flue gas mixtures by using infrared (IR) spectroscopy and thermogravimetric analysis (TGA) have been conducted. Studies of the sorption of $SO_2$ by CuO/$Al_2O_3$ sorbents prepared by the extraction technique were conducted at 325{degree}C with a simulated flue gas mixture. Two approaches were used. First, the spectrum of the flue gas mixture was monitored in a flow cell both before and after exposure to the sorbent. Second, the IR spectrum in the region of 1800--{approximately}1000$cm^{-1}$ was monitored for a wafer of the CuO/$Al_2O_3$/EX sorbent at various times in the presence of the simulated flue gas mixture. From these data, it is concluded that initial sorption of $SO_2$ occurs by reaction of the $SO_2$ with an active site on the sorbent. Upon prolonged exposure to $SO_2$, the presence of the peak at 1200$cm^{-1}$ indicates that sulfate is produced. At this time, the nature of the interaction between the $SO_2$ and the sorbent is not known; however, the presence of the IR peaks at 1400$cm^{-1}$ suggests that the $SO_2$ is absorbed in a molecular form, presumably at a copper site. Further studies to determine the mechanism of absorption of the $SO_2$ and its conversion to sulfate on the sorbent are planned. 4 figs., 1 tab.

7245 **(ICEAS-B—5) FGD handbook.** Klingspor, J.S.; Cope, D.R. (IEA Coal Research, London (UK)). May 1987. 271p. IEA Coal Research, London (UK).

The handbook provides basic information on over one hundred flue gas desulphurisation (FGD) systems for control of sulphur emissions from coal-fired boilers. The full range of systems is included as well as systems offering simultaneous control of sulphur and nitrogen oxide emissions. A major distinction is made between non-regenerable systems and regenerable systems with the former subdivided into the following systems: wet lime; wet limestone; spray dry scrubbing; dual alkali; wet lime/alkaline fly ash; dry post furnace injection; seawater; ionising; E-SO/sub x/; and in-duct spray dry scrubbing. Information is provided on system reagent requirements, nature of the FGD by-product, status of the process, process characteristics such as sulphur dioxide removal levels, together with process flowsheets. For less well-known systems and processes in an early development stage a short process description is also given. The handbook is indexed by vendor, country and system.

7246 **(PB—89-103816/XAB) Manual for applying fluidized-bed-combustion residue to agricultural lands. Research report.** Stout, W.L.; Hern, J.L.; Korcak, R.F.; Carlson, C.W. (Agricultural Research Service, Albany, CA (USA). Western Utilization Research and Development Div.). Aug 1988. 20p. (ARS—74). NTIS, PC A03/MF A01.

Atmospheric fluidized-bed combustion (AFBC) is a process that reduces sulfur emissions from coal-fired electric-generating plants. The residue from the process is a mixture of alkaline oxides, calcium sulfate, and coal ash constituent. Since 1976, USDA/ARS has investigated the potential agriculture use of the residue. The investigations comprised an extensive series of laboratory, greenhouse, field plot, and animal-feeding experiments. The best and safest use of AFBC residue in agriculture was as a substitute for agricultural lime. The report contains guidelines for appling AFBC residue to agricultural lands.

7247 **(SAIC—88/1506) Bench-scale studies on the use of metal-exchanged synthetic mordenite for the simultaneous removal of NO/sub x/ and SO/sub x/ from simulated flue gases: Final report.** Paplawsky, W.J.; Pence, D.T. (Science Applications International Corp., San Diego, CA (USA)). Jan 1988. Contract AC22-83PC60265. 91p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004063/JAW.

The objective of the program was to evaluate the feasibility of utilizing metal-exchanged synthetic mordenite as a material for the simultaneous removal of $SO_2$ and NO/sub x/ from fossil-fuel-fired power generating plants. Based on thermodynamic and known kinetic considerations, iron and copper were selected as the cations for the study, along with CO, $H_2$, and $NH_3$ as the reducing/regeneration gases. Various techniques were studied to provide maximum cation exchange, including impregnation techniques to obtain cation loadings in excess of the maximum theoretical ion-exchanged amounts. Single adsorbent column tests were performed using simulated flue mixtures and test conditions to evaluate the prepared materials and selected regeneration gas combinations. Attrition tests were performed on the cation-exchanged materials to determine if the procedure may degrade the physical strength of the adsorbents. A microprocessor-controlled, automated test apparatus was fabricated and assembled to provide unattended, continuous operation for bench-scale tests for the selected materials and gas combinations. A total of about 50 adsorption-regeneration cycles were performed using two sets of 3-ft-long adsorbent columns. Major conclusions were: (1) greater than 90% $SO_2$ removal and greater than 80% NO/sub x/ removal were demonstrated, (2) adsorbent regeneration was obtained without the use of steam, (3) a high utilization of the exchanged copper was attained, and (4) a hydrogen regeneration gas utilization of hydrogen was demonstrated. 32 figs., 28 tabs.

7248 **Improved ultrasonic extraction recovery of benzo[a]pyrene from stack ash using high power/mass ratios.** Griest, W.H.; Tomkins, B.A.; Caffrey, J.R. (Oak Ridge National Lab., TN (USA)). *Analytical Chemistry;* **60**: No. 19, 2169-2171(1 Oct 1988). Contract AC05-84OR21400.

The difficulties in recovering large-ring PAHs from particulate matter has led to the development of many different extraction approaches, including ultrasonic and Soxhlet extraction using conventional or high-boiling solvents, vacuum sublimation, and supercritical fluid extraction. A common feature of many studies, however, is the extraction of gram to multigram quantities of electrostatic precipitator (ESP) hopper ash, which is readily available in kilogram quantities. This study was initiated after early experiences in a program for the chemical and biological characterization of coal combustion plume fly ash indicated that only 100-250 mg of ash could be properly collected with great effort from a plume by using the current state of the art in airborne sampling technology. This paper reports the results of extraction studies designed for milligram quantities of ash. The findings indicate that the ultrasonic solvent extraction recovery of large-ring PAHs such as BaP can be significantly improved by simply increasing the power/mass ratio.

7249 **Method for the desulfurization of hot product gases from coal gasifier.** Grindley, T. (to Dept. of Energy, Washington, DC). US Patent 4,769,045. 6 Sep 1988. Filed date 13 Jan 1988. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a method for removing sulfur compounds from coal-derived gases produced from the gasification of coal containing sulfur in a gasifier having a gasification zone, a combustion zone and an ash zone, comprising the steps of introducing a mixture of particulate coal and a calcium compound into the gasifier, heating the coal particulates in the gasifier to a temperature adequate to form a coal-derived gaseous mixture containing sulfur compounds including hydrogen sulfide, conveying the gaseous mixture through a bed containing particulate absorbent from zinc ferrite, iron oxide, or combinations thereof for absorbing sulfur compounds including the hydrogen sulfide from the gaseous mixture, thereafter contact the particulate absorbent containing absorbed hydrogen sulfide with a stream of air or oxygen and steam for regenerating the absorbent by converting the hydrogen sulfide to sulfur dioxide, conveying a stream containing steam and the sulfur dioxide resulting from the regeneration of absorbent into the gasifier for contact and reaction with the calcium compound within the gasifier to form therewith a solid sulfur-calcium compound, and removing the sulfur-calcium compound from the gasifier.

7250 **Bioprocessing of coal.** Isbister, J.D.; Wyza, R.E.; Lippold, J.; DeSouza, A.; Anspach, G. (Atlantic Research Corporation, Alexandria, VA (USA)). pp 281-293 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Atlantic Research is currently investigating two approaches to microbial beneficiation of coals. A microorganism capable of removing a portion of the organic sulfur from coals has been developed and patented. A second microorganism is being evaluated for removal of an additional organic sulfur form from coals. As much as 40% of the organic sulfur has been removed in a bench-scale process. A second approach uses naturally occurring pyrite-oxidizing microorganisms to liberate pyritic sulfur from coals through selective comminution before beneficiation of the coal by physical processes. Also under study at Atlantic Research are the biochemical mechanisms by which a microbial consortium depolymerizes coals. A unique microbial consortium has been isolated which is capable of depolymerizing Leonardite, a highly oxidized lignite coal, with no pretreatment. These microorganisms are also capable of depolymerizing other lignites and a sub-bituminous coal, although pretreatment of these coals is required. Relatively rapid and efficient microbial depolymerization has been demonstrated with pretreated lignite and sub-bituminous coals, with production of an alkali-soluble product.

## 0109 Environmental Aspects

*REFER ALSO TO CITATION(S) 7199, 7209, 7212, 7214, 7215, 7216, 7273, 7275, 7279, 9165, 9186, 9295*

7251 **(AD-A—198185/1/XAB) Compliance testing of Grissom AFB Central Heating Plant coal-fired boilers 3 and 5, Grissom AFB, Indiana, Final report, 4-14 March 1988.** Garrison, J.A. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jun 1988. 91p. (USAFOEHL—88-078EQ0025FEF). NTIS, PC A05/MF A01.

At the request of HQ SAC/SGPB, compliance testing (particulate emissions) of coal-fired boilers 3 and 5 in the Grissom AFB Central Heating Plant was performed on 4-14 Mar 1988. The survey was conducted to determine compliance with Indiana Administrative Code, Title 325--Air Pollution Control Board, Articles 5 and 6. Results indicate that boilers 3 and 5 to met particulate standards while exhausting through the bypass stack.

7252 **(CRIEPI-U—86059) Review of the effects of atmospheric pollutants and trace elements on terrestrial plants (Part 3).** (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)). 1988. vp. Abiko Research Laboratory (Japan). Plant Effects Database Committee.

This review summarizes and evaluates papers on the terrestrial plant effects related to air pollutants emitted by thermal power plants including trace elements and gaseous pollutants. 130 papers selected from 94 journals are discussed in the review. Effects of sulfur compounds, nitrogen compounds, coal fly ash, trace elements, acid rain, and oxidants are covered. The papers researched were, for the most part, published from 1981 to 1982.

**7253 (IEACR—01) Trace elements from coal combustion: emissions.** Smith, I.M. (IEA Coal Research, London (UK)). Jun 1987. 87p. IEA Coal Research, London (UK).

This review investigates recent work relating to coal combustion as one of the sources of trace elements to the environment. It assesses the effects of pollution abatement and control technologies on the atmospheric emissions of trace elements, especially those adsorbed on the smallest (respirable) particles and the vapour phase components. Data on the concentrations of trace elements retained in the ash products are presented. Although sampling and analysis techniques impose some limitations on the conclusions which can be drawn, the following main points emerge from this study. Trace elements are retained best by the most efficient particulate control devices, for example ESP and fabric filters (baghouses); flue gas desulphurisation systems improve trace element capture; emissions of trace elements from fluidised bed combustors appear to be similar to those from conventional boilers. The scope of the report excludes consideration of the chemical form and toxicity of the emissions and hence their subsequent pathways and effects in the environment. 258 refs., 29 figs., 25 tabs.

**7254 (PB—88-247929/XAB) Health-hazard evaluation report, HETA-83-210-1887, roofing construction, Houston, Texas.** Zey, J.N. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1988. 40p. (HETA—83-210-1887). NTIS, PC A03/MF A01.

An evaluation was made of possible hazardous working conditions at roofing sites in Houston, Texas. Roofing systems evaluated included: tear off and application of a coal tar pitch system; tear off and application of a petroleum asphalt system; and application of a single-ply modified asphalt system (Koppers). Personal exposures to hazardous materials were highest in the coal tar pitch operation with 85 hydrocarbons (PNAs). Medical evaluation indicated eye and skin irritation and lesions in workers. The author concludes that workers were exposed to potentially hazardous concentrations of coal-tar pitch and petroleum asphalt roofing sites. The author recommends specific measures to reduce exposures, including better personal hygiene, use of personal-protective equipment, staying upwind of dust and fumes, wetting roofs before tear off, use of sunscreens and avoiding work during the hours of greatest sun intensity.

## 0110 Reserves And Exploration

**7255 (CU/G—8303) Reflection seismic investigations of western Canadian coalfields. Final report.** Lawton, D.C.; Bertram, M.B. (Calgary Univ., Alberta (Canada). Dept. of Geology). Mar 1983. 66p. (CE—01964). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

High resolution reflection seismic studies using a seisgun surface source were undertaken at four sites in Alberta. The objective of the project was to test the feasibility of the seismic method for the exploration and evaluation of coal deposits in a range of environments in western Canada. At Camrose, coherent reflections from a coal zone 70-110 m below the surface were recorde along a 5 km profile. Variations in reflection amplitude and character were interpreted in terms of two main seams. Channel washouts, faults with throws of 5 m or greater, and effects of differential compaction were resolved. Studies at a foothills site showed that good data can be obtained in structurally disturbed areas with mild deformation. At this site, faults with vertical throws of up to 40 m were delineated. In the mountain region, studies indicated that the seismic method is not appropriate in areas with strong deformation. Deep weathering, variable topography and rapid lateral changes in reflector dip were the main reasons for poor data quality. The seisgun is a threshold seismic source which performs well in areas with a shallow water table and a zone of interest within 350 m of the surface. Its effectiveness decreases dramatically if the overburden is both thick and dry. Careful selection of field geometry and recording parameters is critical. In data processing, important aspects are the careful muting of first breaks and evaluation of short and long wavelength weathering statics corrections. A computer program listing for static correction analysis is included. The seismic method is very appropriate for evaluation of Plains and Foothills coal deposits in Alberta. It can provide continuous subsurface coverage between drillholes and therefore reduce the density of drillholes required to delineate a prospective area. 29 refs., 33 figs., 2 tabs.

**7256 (LF—2043) Lignite to methanol fuel: deposit selection studies. Final report.** (Liquid Fuels Trust Board, Wellington (New Zealand)). Jul 1987. 368p. Liquid Fuels Trust Board, Wellington (New Zealand).

This report assesses the viability of South Island Lignite resource to support a large scale synthetic fuel development. Contents include: a shortlisting of deposits and process technologies; resource definition studies; geotechnical and hydrological studies; meteorological and air quality studies; ecological studies; sociological and socio-economic studies; mine planning studies; lignite conversion process studies; development schedule and infrastructure requirements; project economic analysis; and comparative evaluation of project sites. 78 figs., 60 tabs.

## 0120 Mining

*REFER ALSO TO CITATION(S) 7385*

**7257 (AD-A—198033/3/XAB) From Tuscaloosa to Squaw Shoals: a history of Holt Lake, Alabama.** Wood, K.G. (Southeastern Archeological Services, Inc., Athens, GA (USA)). 15 Jul 1988. 113p. NTIS, PC A06/MF A01.

An archival study was performed for Corps of Engineers land at Holt Lake, located north of Tuscaloosa, Alabama, on the Black Warrior River. The project area lies at the southern terminus of the Warrior Coal Fields, which are dissected by the Black Warrior River. Much coal-mining activity has taken place in the area historically. But coal mining did not increase significantly until the early twentieth century when the building of several railroad lines into the area facilitated coal operations. The construction of locks on the Black Warrior River north of Tuscaloosa in the early twentieth century allowed year-round traffic on the Black Warrior River which added extra impetus to the coal mining industry. Three lock sites, portions of a railroad complex (including the road grade, a tunnel, and trestle piers), a probable twentieth century house site, a small cemetery, a historic artifact scatter, and two aboriginal sites were identified during a survey of the area. The lock sites and the railroad complex do not appear to be eligible for nomination to the National Register of Historic Places because a great portion of them have been destroyed or submerged by the construction of Holt Lock and Dam.

**7258 (CANMET—SP87-5) Index of mining technology projects 1987.** Billette, N.; Lacourse, P. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Sep 1987. 212p. Canadian Government Publishing Centre, Ottawa, Ontario, Canada: 21.50 dollars; Other Countries: 25.80 dollars.

This report contains the results of CANMET's 1987 survey of work conducted on mining research and technological developments in Canada. Detailed information on projects in the index must be obtained from the contact person listed for each project. The index provides a listing of projects by the performing organization and also divides the projects into 12 categories including administration, design, equipment, materials handling, etc.

**7259 (CMRC—83/17-T) Evaluation of drainage measures taken at the Whitewood mine, 1979-1982.** Wright, P.L. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). Apr 1983. 31p. (CE—01961). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes the monitoring procedures and benefits obtained from surface drainage works undertaken at the Whitewood coal mine in Alberta. The scheme finally involved the excavation of a box pit on part of the extremity of the proposed mining area, main surface ditches with minor finger ditches, two draining wells and a monitored pumping scheme. The report illustrates that simple graphical interpretation of piezometer readings

can indicate the effect of drainage measures. The drainage methods undertaken resulted in steeper spoil angles, permitting a wider pit, and contributed to a significant increase in coal release per unit area. 2 refs., 22 figs.

7260 **(CMRC—83-28-T) Braking performance of mine trucks completion report.** Wright, P.L. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). May 1983. 34p. (CONF-8209311—; CE—01958). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From International conference on mining transport and handling systems; Birmingham, UK (1 Sep 1982).

The two papers in this report form the completion of work instigated under a program investigating the braking performance of mine trucks. One report considers the design parameters involved in scaling up mine trucks to the 1,000 tonne level. The other involves a mathematical analysis of the braking process in mine trucks and applying this to the safe control of trucks. Separate abstracts have been prepared for both papers.

7261 (CMRC—83-28-T, pp 10) **The dynamics of a loaded mine truck descending a grade with banked curves.** Doige, A.G.; Walker, G. (Univ. of Calgary, Alberta). May 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8209311—; CE—01958).

From International conference on mining transport and handling systems; Birmingham, UK (1 Sep 1982).

A study has been made of the dynamics of a loaded truck descending a grade with banked curves. This study follows earlier work to improve the braking performance of trucks used in mountain mining service following several accidents with runaway trucks. The analytical model developed in this paper simulates the primary dynamic characteristics that relate to braking and steering control of the vehicle. Numerical computations based on the analysis help to identify quantitively the relative importance of the various road parameters such as slope, bank angle, curvature and surface conditions as well as for several vehicle parameterssuch as location of the centroid and the distribution of braking effort. Most of the significant features can be incorporated in a single plot that can be used to assess relative safety and braking capacity for combinations of speed and front/rear braking ratios. 6 refs., 5 figs.

7262 (CMRC—83-28-T, pp 24) **Behold Behemoth: toward the 1,000 tonne truck.** Walker, G. (Univ. of Calgary, Alberta). May 1983. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8209311—; CE—01958).

From International conference on mining transport and handling systems; Birmingham, UK (1 Sep 1982).

The payloads of rear-dump off-highway trucks have increased an order of magnitude from 30 to 300 tonnes in the past 40 years. There is every expectation this trend will continue as the scope and scale of mining operations increase. In this paper the historical data is compiled and analysed to establish the power laws governing the past development of mine trucks and the principal defining parameters thereof. Surprisingly close agreement was found to exist for the products of all vehicle manufacturers. The power laws are then projected to determine the geometry and configuration of 500, 750 and 1,000 tonne trucks. Although a 1,000 tonne payload is an extended projection, it is far less than the decade (35 to 350 tonne) on which the power law rests. It is thereby possible to predict the size shape, cost, date of introduction and even the manufacturer of the 1,000 tonne truck, presuming the historical trends continue. The case against progressive and unlimited increase in the size of conventional rear dump trucks is presented. The paper concludes witha speculative discussion of improved geometry and arrangements for the very large, remote controlled vehicles of the future. 2 refs., 14 figs., 2 tabs.

7263 **(CRL—87-90(TR)) Remote on-board coal quality sensing techniques in coal cutting and handling systems.** Szymanski, J.K.; Golosinski, T.S.; Srajer, V. (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Lab.). Sep 1987. 37p. Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Lab.

A review of the literature was undertaken to determine the potential for development of instrumentation for on-board remote sensing of coal quality. This review report acts as an inventory of commercially available techniques being tested or under development, particularly in the areas of the cutting horizon measurement methods associated with longwall mining equipment and coal/waste monitoring techniques in coal handling systems. While technology is available which can discriminate rocks from coal on a conveyor belt, the literature indicates that this hardware has yet to be adapted to continuous surface mining machines. 23 refs., 18 figs.

7264 **(CRL—87-120(TR)) 'WILSN-CL' users guide: IBM-PC/AT computer calculation of diametric tunnel closure using the NCB Wilson formula.** Kearney, P.; Aston, T.R.C. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Nov 1987. 15p. CANMET, 555 Booth St., Ottawa, Canada K1A OG1.

This paper provides an introduction to the 'WILSN-CL' computer program, which calculates diametric tunnel closure based on a formula developed by the National Coal Board (UK). The program, is written in BASIC A Version 3.10 for an IBM-PC/AT microcomputer. 1 ref., 3 tabs.

7265 **(EUR—11427-FR) The forecasting and controlling of sudden failures of coal faces in dipping seams.** Revalor, R. (Commission of the European Communities, Luxembourg). 1988. 87p. (In French). Commission of the European Communities, Luxembourg.

A number of dynamic events have occured during recent years in the West field of some dip seams in the Simon mine, extending as far as sudden spontaneous projections of the coal face. These events are very different from the more traditional falls of faces that have occured for many years in this deposit, on account of their suddenness, their violence and the extent of the observed effects. Details are given on natural factors and mining situations that appear to have a determinant effect on triggering these events, such as the tectonic structure of the area, natural and mining stresses and the type of strata. These factors are used at two levels: for the analysis of the failure mechanisms of these events, which are specified and of which knowledge is needed to combat them; for the fight against such events, which is centred on the large-scale mining strategy and the implementation of local methods for forecasting and preventing such happenings at the working face. Taking into account the difficulties in applying local methods, an adequate mining strategy, integrated from the start of planning, appears to be essential when mining this type of seam.

7266 **(EUR—11477-EN) Investigation of fire damp and its emission in coal seams.** (British Coal, Stanhope Bretby. HQ Technical Dept.). 1988. 141p. British Coal, Stanhope Bretby (United Kingdom). Headquarters Technical Dept.

New findings and developments arising from research into the following topics are described: seam gas content measurement techniques, geological controls on the occurrence and distribution of firedamp, gas emission characteristics of coals and coal seams, migration of gas in strata disturbed by mining, and occurrence of gas in strata other than coal seams. Computer implemented methods for calculating likely gas emission quantities in longwall workings and assessing the risk of unusual emission levels have provided the industry with some powerful ventilation planning tools.

**7267 (MC—8706) Peat slurry pumping/pipeline trials on a Canadian peatland site.** (Monenco Consultants Ltd., Rexdale, Ontario (Canada)). 1987. vp. (MICROLOG—88-06160). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An objective of this project was to assess the performance of a hydraulic peat mining and slurry pipeline transport system, through full scale field trials on a typical Canadian peatland site. A site in Ontario was selected which offered suitable access, variation of peat type and degree of decomposition, adequate water supply, minimum site preparation and other features considered important in project budget and schedule control. At the actual excavation site, the peat layer was underlain by ooze of variable thickness which proved to be easily penetrated by the water jets during mining and resulted in relatively high ash contents in most of the peat slurries. The peat depth at the test site (up to 2.3 m) is considered about minimum for use of the hydropeat mining system. The site had a high stump content; this feature was considered important for evaluation of mining system performance since the presence of such debris is known to adversely affect peat extraction. The mining equipment set worked well in this environment. The modified hydropeat mining method used in the test is a practical method of harvesting peat. Peat was successfully excavated in slurry form from the bog and transported to drying fields elsewhere on the bog. Viability of larger commercial-scale systems was confirmed. A number of conclusions were reached on matters to be considered in the design of peat slurry pump/pipeline systems. 11 refs., 108 figs, 52 tabs.

**7268 (PB—88-245360/XAB) Ergonomic guidelines for control-room software used with automated vertical guidance of shearers. Technical memo. (Final), January 1986-December 1987.** Talbot, C.F.; Collier, S.G.; Graveling, R.A. (Institute of Occupational Medicine, Edinburgh (UK)). Jan 1988. 180p. (TM—88/02). NTIS, PC E09/MF E09.

Color illustrations reproduced in black and white.

Technological changes have brought about a considerable growth in automated systems in coal mining. Among these has been the advent of the auto-steering (vertical guidance) of shearers. The project was concerned with providing ergonomic guidelines for the design of software for this surface monitoring facility. In particular, it addressed factors such as the interactive dialogue and the design of the displays used by the system.

**7269 (PB—89-104053/XAB) Effect of shearer web depth on dust generation and methane liberation. Report of investigations/1988.** Organiscak, J.A.; Doyle-Coombs, D.M.; Cecala, A.B. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 6 Nov 1987. 18p. (BM-RI—9180). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 88-600112.

The Bureau of Mines recently investigated dust generation and methane liberation during half- and full-web cutting at a double-drum shearer longwall face. The study was conducted to ascertain the health and safety aspects of wider web shearing at longwalls. Results from these underground tests showed that deeper web cutting reduced dust generation and methane liberation per ton of coal mined, while significantly improving shearer production rates. When cutting with the airflow (head-to-tail cut pass) full-web cutting decreased dust generation per ton by 16 pct at the shearer and 6 pct at the tailgate, with an increase in shearer production rate of 72 pct. Methane liberation per short ton also decreased by 36 pct at the shearer and 22 pct at the tailgate. Full-web cutting against the airflow (tail-to-head cut pass) decreased dust generation per ton by 41 pct at the shearer and 37 pct at the tailgate over half-web cutting, with an increase in shearer production rate of 61 pct. Methane liberation per ton also decreased by 35 pct at the shearer and 41 pct at the tailgate. These improvements for full-web cutting are a reflection of improved cutting efficiency (less dust and methane produced from cutting) and less new face area exposed per ton of coal mined (less methane liberated from face per short ton of coal mined).

**7270 (PB—89-104087/XAB) Horizontal trajectories of rotary-drilled holes. Report of Investigations/1988.** Goodman, T.W.; Cervik, J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1988. 18p. (BM-RI—9177). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 88-600114.

The Bureau of Mines report investigates the horizontal trajectory of boreholes drilled in coalbeds using the rotary drilling technique. Test holes drilled in coalbeds showed that the path of a borehole in the horizontal plane depends on drilling assembly configuration, drill-bit rotation, and coalbed geologic features. An assembly that contained an 18-ft (5.5-m) long drill collar and two centralizers had the best horizontal stability evidenced by trajectories that deviated less than 16 ft (4.9 m) from a target at 1,000 ft (305 m). Removal of one of the centralizers resulted in a loss of control of hole trajectory in the horizontal plane. Generally, holes tended to turn to the right, presumably because of right-hand rotation of the bit. Deviations from the original bearing line were as much as 200 ft (61 m) or more at a depth of 1,000 ft (305 m).

**7271 (PB—89-107361/XAB) Factors affecting strength and stability of wood cribbing: height, configurations, and horizontal displacement. Report of Investigations/1988.** Barczak, T.M.; Tasillo, C.C. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Sep 1987. 30p. (BM-RI—9168). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 87-600482.

This report describes a study that investigates three parameters influencing the load-carrying capability of wood-crib supports: height, configuration, and horizontal displacement. Four crib heights, four parallelogram configurations, and three ratios of horizontal-to-vertical displacements were tested on full-scale wood crib supports in a mine roof simulator. Test results indicated a reduction in load-carrying capability for increases in crib height. The report documents these tests and postulates some explanations of failure mechanics for the observed behavior.

**7272 (PB—89-108781/XAB) Methane control research: summary of results, 1964-80.** Deul, M.; Kim, A.G. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1988. 189p. (BM-B—687). NTIS, PC A09/MF A01.

Also available from Supt. of Docs. Library of Congress catalog card no. 85-600330.

This report summarizes work conducted during the years 1964 to 1979. The research effort was directed toward improving existing methods and developing alternative methods of reducing the explosion hazard during mining. Topics discussed in the bulletin include the magnitude of the methane problem; the equipment and instruments developed; the geological, chemical, and physical parameters that control the movement of methane in coalbeds; the direct method of determining gas content; the estimates of gas content from adsorption data; and methane drainage through shafts, through horizontal boreholes, or through vertical boreholes, or through slant holes. Improvements in ventilation, control of methane in gob areas, and water infusion are also discussed. The report provides a comprehensive source of information on the accomplishments of the Bureau's methane control research program, on the technology developed, and on the direction of further research.

**7273 (PB—89-109185/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on the Mine Safety and Health Administration's proposed rule on safety standards for underground coal-mine ventilation.** Millar, J.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 16 Jun 1988. 7p. NTIS, PC A02/MF A01.

The testimony summarized information contained in written comments on the proposed rule on mine ventilation submitted on April 28, 1988. The proposed regulation included a number of significant improvements over existing standards. The requirements eliminated aluminum overcasts, required fireproof mortar in permanent stoppings and fire-resistant coatings on timbers used as stoppings, and improved the requirements for underground electrical installations. New rules for escapeways provided additional protection in the event of an emergency under ground. A carbon monox-

ide fire-detection system provided a major margin in risk reduction. The testimony indicated that NIOSH did not support the use of belt haulageways as intake air courses at any time. Anthracite miners appear to be at twice the risk of coalworkers' pneumoconiosis compared to bituminous coal miners. Special attention must be given to controlling dust levels in anthracite mines.

7274 **(PB—89-112320/XAB) Surface testing and evaluation of the conveyor-belt service machine. Information Circular/1988.** Jaspal, J.S.; Miller, L.F. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 30 Dec 1987. 39p. (BM-IC—9190). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 88-600104.

The Bureau of Mines developed a conveyor-belt service machine (CBSM) through a research contract with Tractor MBA. The CBSM is a self-contained, battery-powered, rubber-tired vehicle capable of handling, storing, and transporting conveyor belting, wire rope, and associated belt structures in seams as low as 48 in. Belt extensions and retractions are accomplished by moving the tailpiece of a belt conveyor with the CBSM to the next position while dispensing or retrieving the belt, wire rope, and associated belt structures. The CBSM improves the belt extensions and retractions by making them easier and faster, and it utilizes fewer workers. The CBSM was surface tested at the Bureau's Mining Equipment Test Facility to evaluate its performance and reliability. Modifications were made to the CBSM to correct deficiencies found during surface testing.

7275 **(SP—86-2) Biotechnology bibliographies.** Beaudette, L.A.; McCready, R.G.L. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1986. 115p. Canadian Government Publishing Centre, Ottawa, Ontario, Canada 12.50 dollars; Other Countries; 15.00 dollars.

This bibliography consists of articles and scientific papers on biotechnology in areas in which BIOMINET is currently involved. The reports are categorized in four areas: 1) acid mine drainage (coals and metals) and bioadsorption of metals; 2) solution mining; 3) metabolism and physiology of Thiobacillus and other microorganisms; and 4) bacterial leaching of metals.

7276 **(SP—86-4) Index of underground environment dust reports: CANMET/Mining Research Laboratories 1960-1985.** Grenier, M.G.; Butler, K.C. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Apr 1986. 19p. Canadian Government Publishing Centre, Ottawa, Canada: 4.25 dollars; Other Countries: 5.10 dollars.

This bibliography lists 123 reports on the subject of underground environmental dusts. Specifically chosen by the staff of the Mining Research Laboratory, the reports have been categorized into five sections: instrument calibration and design; X-ray diffraction technology for quartz dust assessment; results of underground dust surveys; dust measurement techniques and measures; and dust control underground.

## 0130 Transport And Handling

*REFER ALSO TO CITATION(S) 7267*

7277 **(DOE/PC/90517—T2) Extruded coal capsules for transport in fiber-water flow: Eighth quarterly technical progress report, June 15, 1988--September 16, 1988.** Liu, H. (Missouri Univ., Rolla (USA). Dept. of Civil Engineering). 1988. Contract FG22-86PC90517. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002723/JAW.

## 0140 Combustion

*REFER ALSO TO CITATION(S) 7198, 7229, 7253, 7714, 8772*

7278 **(CANMET—87-4E) A data package for the validation of a computer model of the CCRL tunnel furnace facility.** Hughes, P.M.J. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1988. 215p. Canadian Government Publishing Centre, Ottawa, Ontario K1A OS9. Canada: 20.50 dollars; Other countries: 24.60 dollars.

A number of experiments were carried out in the tunnel furnace facility of CANMET's Combustion and Carbonization Research Laboratory, to obtain data that can be used to validate coal or oil flame computer models. This report describes tests in the tunnel furnace in which low- and high-volatile coals were burned at two swirl settings and compared to oil. A discussion of the measurement techniques and the reliability of the data is included. The data resulting from the report are expected to be useful in the comparison of measured and predicted values for most of the information available from currently used computer codes. It is expected that the data will respond to the deficiencies of data packages previously prepared but not specifically generated for comparison with computer predictions. 7 refs., 98 tabs., 11 figs., 2 append.

7279 **(DOE/METC—88/6090) A survey of emission levels and an evaluation of sampling and analyses methods for polycyclic aromatic hydrocarbons in combustion streams.** Pineault, R.L. (USDOE Morgantown Energy Technology Center, WV). Sep 1988. 214p. NTIS, PC A10/MF A01 - OSTI. Order Number DE88001039/JAW.

This report, authored by scientists at the Morgantown Energy Technology Center (METC), addresses various aspects of polycyclic aromatic hydrocarbon (PAH) release from combustion sources that should be considered in determining the need for measurement of PAHs in emissions, and the methods to be used in their sampling and analysis. Because of the large degree of uncertainty and controversy surrounding the toxic effects of even trace amounts of PAHs and other carcinogens on the public welfare, there has been substantial emphasis on the development of analytical instrumentation to measure trace levels of PAH and related compounds in a wide variety of emission sources and environmental samples. New laser-based techniques taking advantage of the real-time selectivity and high sensitivity afforded by laser-induced fluorescence and resonance multi-photon ionization/time-of-flight spectrometry offer potential for accurate on-line monitoring of PAH in product of combustion (POC) streams. These new techniques may also serve as highly selective and sensitive detectors which can enhance existing chromatographic methods of PAH analysis. 428 refs., 20 figs., 29 tabs.

7280 **(DOE/PC/79660—1) Advanced Vortexing Combustor (VC) for space/water heating applications (proof-of-concept model development): Technical progress report No. 1.** Fu, T.T. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Mar 1988. Contract AI22-87PC79660. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89001526/JAW.

The Naval Civil Engineering Laboratory (NCEL), under Interagency Agreement DE-AI22-87PC79660 with the Department of Energy, Pittsburgh Energy Technology Center (PETC), was tasked to develop the vortexing combustion technology for coal. This project is for a period of 27 months beginning on 30 September 1987 and ending on 29 December 1989. At the conclusion of this work, a 2-4 MMBtu/hr proof-of-concept Vortexing Combustor (VC) capable of burning both coal-water fuel and ultrafine coal will have been designed, built, and tested to demonstrate the concept. This is the first of the quarterly technical progress report covering the period 30 September 1987 to 31 January 1988. 5 figs., 1 tab.

7281 (EMR/MB—RFC72/95-CCRL, pp 31-66) **A preliminary study of the combustion of coal-in-oil slurries.** Brown, T.D.; Lee, G.K. Dec 1973. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-7205129—; CE—01973).

From Coal-in-oil seminar; Ottawa, Canada (17 May 1972).

Results from combustion experiments using coal-in-oil fuel indicate that it is a feasible fuel for use in conventional combustion systems. A lignite slurry comprising 33 wt% lignite in No. 2 oil gave combustion efficiencies greater than 90% at excess air levels above 12%. On the other hand, combustion efficiencies of the order of 50% were measured using a reject bituminous coal having a high content of the non-reactive fusinite and semi-fusinite macerals. Thus, the degree of burn out of the coal component is strongly dependent on both the maceral components of the coal and the aerodynamic patterns in the flame. 9 refs., 6 figs., 4 tabs.

**7282 (IS—4956) Real time monitoring of sodium and potassium concentrations in flue gas produced during July and August 1987 coal combustion/hot gas cleanup studies at the Grimethorpe (England) PFBC establishment.** Haas, W.J. Jr.; Eckels, D.E. (Ames Lab., IA (USA)). Jul 1988. Contract W-7405-ENG-82. 92p. NTIS, PC A05 - OSTI. Order Number DE89003745/JAW.

The first of two latest-generation alkali monitors produced for the US Department of Energy Morgantown Energy Technology Center (METC) by the Idaho National Engineering Laboratory (INEL) was employed with an acetylene/nitrous oxide flame for determination and real time monitoring of total sodium and total potassium concentrations in hot pressurized fluidized bed combustor flue gas produced by the Grimethorpe PFBC and cleaned by a state of the art ceramic candle filter assembly. The feeding methods for the Glenn Brooke coal and Plum Run dolomite employed throughout included separate and combined coal sorbent feed, and both dry feed and slurry feed. The problems and potential problems pertinent to the METC/INEL alkali monitor that were encountered in this first field application of the instrumentation are also reported. 14 refs., 2 figs., 5 tabs.

**7283 (PB—89-117535/XAB) Coal/Water Fuel supply and conversion study. Final report.** (Atlantic Research Corp., Alexandria, VA (USA)). Aug 1985. 97p. NTIS, PC A05/MF A01.

This report analyzes the feasibility of converting oil-fired boilers to Coal/Water Fuel. It also presents a design and cost analysis for a CWF production facility. Fuel transportation, handling and storage, and environmental issues also are discussed. Conversion costs to CWF for two 22,000 lbs. steam/hr. boilers were estimated. These boilers were originally designed and constructed to burn coal, but were converted to, and are currently burning oil. Most of the coal handling equipment was removed or is no longer usable. Outside coal-storage piles are no longer permitted due to space limitations and to fugitive dust and ground-water pollution concerns. CWF appeared to be the best alternative fuel to replace fuel oil at this site. The report concludes that due to the expected decline in future steam demand at the site, it was highly unlikely that more than one boiler would be in operation long enough to justify conversion. As a result, several additional CWF consumers would have to be found in the area to enable the construction of a large enough CWF production plant to produce the fuel at a price competitive with oil.

**7284 (QFBC-TR—87-4) Mathematical modelling of fluidized bed coal combustion.** Becker, H.A.; Code, R.K.; Gogolek, P.E.G. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1987. 14p. CANMET, 555 Booth St., Ottawa, Ontario, Canada K1A OG1.

This interim report provides an outline of the authors' work on modelling fluidized bed combustors. It is divided into four sections: 1) a description of the framework of assumptions used in developing the model; 2) a presentation of most of the equations and the proposed method of solution; 3) details of the model and the programming, and 4) a summary of future work required to complete and extend the model. 2 refs.

## 0150 Marketing And Economics

**7285 (EUR—10367) Energy 2000.** Guilmot, J.F.; McGlue, D.; Valette, P.; Waeterloos, C. (Commission of the European Communities, Luxembourg). 1986. 270p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

This book outlines the energy supply and demand forecasts for the European Economic Community using a variety of scenarios and assumptions. The forecasts and predictions are quantified for each of the member countries and the results were compared with other studies from around the world. A series of models was developed allowing for external manipulations of economic, political and technical factors.

## 0160 Health And Safety

*REFER ALSO TO CITATION(S) 7272, 7276*

**7286 (CRIEPI-U—86036) A review on the health effects of trace elements in the atmosphere - part 4.** (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)). 1987. vp. (In Japanese). CRIEPI (Japan). Abiko Research Laboratory.

The review summarizes and evaluates the results of papers on the health and biological effects related to environmental trace elements and substances emitted from coal-fired power plants. 118 papers selected from 500 published references are involved. The trace elements and substances investigated are as follows: chromium, mercury, selenium, lead, arsenic, beryllium, manganese and POM.

**7287 (PB—88-245303/XAB) Joint investigations of new generations of dust sampling instrument. Technical memo. (Final), July 1985-December 1987.** Vincent, J.H.; Mark, D.; Witherspoon, W.A.; Parker, I. (Institute of Occupational Medicine, Edinburgh (UK)). May 1988. 96p. (TM—88/09). NTIS, PC E06/MF E06.

The need has been identified for further research into the effects of exposure to airborne dust by workers in the mining industry. In this study, nine instruments from the new generation and five from the old were studied. In addition, thin-walled isokinetic probes were used as reference samplers. Some of these devices are static samplers, others are personal samplers. Experiments were carried out in the large wind tunnel. Underground trials were also carried out at a coal mine in the North of England. In the experiments, the performances of the instruments were compared in relation to their abilities to provide information about given dust fractions; namely, total dust and the inspirable, thoracic, respirable, and alveolar fractions.

**7288 (PB—88-245329/XAB) Animal studies to investigate the deposition and clearance of inhaled mineral dusts. Technical memo. (Final), October 1984-September 1987.** Jones, A.D.; Vincent, J.H.; McMillan, C.H.; Johnston, A.M.; Addison, J. (Institute of Occupational Medicine, Edinburgh (UK)). Apr 1988. 153p. (TM—88/05). NTIS, PC E08/MF E08.

The influence of various factors (including electrical charge, exposure concentration, duration of exposure, and particle toxicity) on the deposition and clearance of inhaled mineral dusts was investigated in experiments with rats exposed to dust for 7 hours per day, 5 days per week. The main program of experiments was directed at elucidating the accumulation of lung burden during chronic (i.e., repeated) exposure. For this, rats were exposed to a toxic dust and a relatively non-toxic dust (titanium dioxide). The results showed that lung burdens scaled with respect to exposure concentration, lung burdens increased progressively with exposure time, lung burdens decreased with time post-exposure, and transfer to lymph nodes appeared to commence when the lung burden reached a threshold level which was higher for the non-toxic dust than for the toxic dust. The accumulation of lung burden was modelled mathematically by incorporating a sequestration compartment into a conventional model with two clearance compartments.

**7289 (PB—88-245337/XAB) Studies on the cellular response in lung tissue to the inhalation of mineral dust. Technical memo. (Final), October 1984-September 1987.** Donaldson, K.; Bolton, R.E.; Brown, D.M.; Brown, G.M.; Cowie, H.A. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1988. 146p. (TM—88/01). NTIS, PC E07/MF E07.

A study was designed to investigate whether dusts collected from British coal mines of different rank, and hence with different mineralogical content, would produce differences in bronchoalveolar leukocyte response in rats exposed to the dusts by inhalation. Airborne dusts were collected from three collieries producing coals of different type: - anthracite, high rank coking coal and low rank bituminous coal. These dusts were generated as respirable clouds and groups of rats were exposed for up to 75 days. Rats exposed for 32 or 75 days and allowed to breathe room air for 2 further

months were also studied. Groups of 4 rats were removed from the exposure chambers on days 2, 4, 8, 16, 32, 52, and 75 and were analyzed for bronchoalveolar leukocyte response by analysis of bronchoalveolar lavage profile.

7290 **(PB—88-246319/XAB) Respiratory infections in coal miners exposed to nitrogen oxides, July 1988. Report for October 1984-October 1987.** Jacobsen, M.; Smith, T.A.; Hurley, J.F.; Robertson, A.; Roscrow, R. (Institute of Occupational Medicine, Edinburgh (UK)). 1988. 70p. NTIS, PC A04.

See also PB—88-198494.

Coal miners who work underground may be exposed chronically to low levels of nitric oxide (NO) and nitrogen dioxide ($NO_2$) from diesel-engine emissions and explosives use. Nine British coal mines have been involved in a prospective epidemiological study of coal miners' health since 1954. Individuals' nitrogen oxides exposures were estimated by multiple regressions that used NO and $NO_2$ concentrations associated with different underground locations, the types of work and mining conditions, and miners' attendance records at similar locations. Information from five-yearly medical surveys were available. Health questionnaire responses from 21,490 men were examined in relation to estimates of exposures to nitrogen oxides. There were no consistent associations between the indicators of respiratory infections and estimates of occupational exposures to NO or $NO_2$.

7291 **(PB—88-252606/XAB) Federal coal mine health program in 1971.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1971. 121p. NTIS, PC A06/MF A01.

Also available from Supt. of Docs. See also PB—83-139410.

This report describes the activities of NIOSH under the regulations of the Federal Coal Mine Health and Safety Act of 1969. The studies included biochemical research, pathological examinations, studies of the role of infectious diseases in the progression of coal workers' pneumoconiosis, and clinical and physiological measurements. Coal-dust sampling instruments were further refined in 1971 to provide better data collection capabilities in the field. Threshold-limit values were recommended for noise in mining operations.

### 0170 Legislation And Regulations

*REFER ALSO TO CITATION(S) 7285*

## 02 PETROLEUM

### 0201 Reserves

*REFER ALSO TO CITATION(S) 7352, 7943*

### 0202 Geology And Exploration

*REFER ALSO TO CITATION(S) 7302, 7307, 7343, 7344, 7364, 9342*

7292 **(AD-A—199354/2/XAB) Radar detection of hydrocarbon gas seepage associated with underground oil and gas deposits. Memorandum report.** Skolnik, M.I. (Naval Research Lab., Washington, DC (USA)). 12 Jul 1988. 45p. (NRL-MR—6245). NTIS, PC A03/MF A01.

Small, simple marine radars have been successfully used for finding gas seepage indicative of oil or gas producing fields. There has been some controversy about the method of operation and the physical phenomenon detected by the radar; but the basis for the technique is now better understood after discussions with the inventor, Robert Owen, and by observing how he operates in the field. It is believed that the radar is detecting the turbulence introduced in the lower atmosphere by the escape of hydrocarbon gases from the ground. Suggestions are offered for better understanding and exploiting this radar method for detection of hydrocarbon gases.

7293 (CERI—1988, pp 6) **Papua, New Guinea - petroleum exploration opportunities.** 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

An outline is presented of the government oil development policies in Papua, New Guinea, including licensing requirements, administration of petroleum activities, and the fiscal regime pertaining to the oil industry. The relatively unexplored Papuan, Cape Vogel and North New Guinea Basins are described with reference to petroleum exploration and discoveries. A list of petroleum prospecting licenses granted to August 1988 is included. 5 figs., 2 tabs.

7294 **(PB—88-251020/XAB) Gulf of Alaska/Cook Inlet Sale 88, Alaska Outer Continental Shelf, final environmental impact statement. Volume 2. Appendices.** Swanton, N.; Tracy, K.V. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Jul 1984. 193p. (MMS/AK/EIS—84/004-VOL-2). NTIS, PC A09/MF A01.

See also Volume 1, PB—88-251012. Portions of this document are not fully legible.

The Environmental impact statement EIS analyzes a proposed oil and gas lease sale in the Gulf of Alaska/Cook Inlet, alternatives to the proposal. The proposal consists of 4,796 blocks located in the Gulf of Alaska/Cook Inlet Planning Areas in waters that are from about 5 to 241 kilometers offshore. The potential effects of the leasing proposal are based in part on the assumption that the mean-resource estimates of 120 million barrels of oil in the Cook Inlet/Shelikof Strait and 530 million barrels of oil in the Gulf of Alaska Planning Areas would be discovered and produced. The study describes the effects on endangered species; communities, economy and schedule of development.

7295 **(PB—89-100721/XAB) Northern Gulf of Mexico continental slope study. Annual report (Year 3).** (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Feb 1988. 1487p. NTIS, PC E99/MF E99.

Set includes PB—89-100739 through PB—89-100754. See also PB—86-246345, and PB—86-246352.

A separate abstract was prepared for each of the 3 volumes of this set.

7296 **(PB—89-100747/XAB) Northern Gulf of Mexico continental slope study. Annual report (Year 3), Volume 2. Technical report.** Gallaway, B.J.; Martin, L.R.; Howard, R.L. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Feb 1988. 616p. NTIS, PC A99/MF A01.

See also Volume 1, PB—89-100739, and Volume 3, PB—89-100754; Also available in set of 3 reports PC E99, PB—89-100721.

In 1983, the Minerals Management Service initiated a multiyear program to study the continental slope of the northern Gulf of Mexico as part of its outer continental shelf environmental studies program. The particular program, the Northern Gulf of Mexico Continental Slope Program, has three primary goals: (1) to determine the abundance, structure, and distribution of animal communities in the deep sea Gulf of Mexico; (2) to determine the hydrography and bottom conditions at selected sites within the study area and to relate these to faunal variations; and (3) to measure present levels of hydrocarbon contamination in deep sea sediments and selected animals. Volume I is the annual technical report, and Volume III is the appendices, which summarizes all data collected over five cruises during the first two years of the study. Year 3 was dedicated to finishing the sample analyses and compiling data. This report provides (1) a detailed description of all field collection, laboratory analyses, and data-management methods, and (2) a comprehensive summary of all the data collected that have been submitted to NODC in specified tape report. Volume III contains four massive appendices detailing all data collected.

7297 **(PB—89-100754/XAB) Northern Gulf of Mexico continental slope study. Annual report (Year 3), Volume 3. Appendices.** Gallaway, B.J.; Martin, L.R.; Howard, R.L. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Feb 1988. 715p. NTIS, PC A99/MF E04.

See also Volume 2, PB—89-100747; Also available in set of 3 reports PC E99, PB—89-100721.

In 1983, the Minerals Management Service initiated a multi-year program to study the continental slope of the northern Gulf of Mexico as part of its outer continental shelf environmental studies program. The particular program, the Northern Gulf of Mexico Continental Slope Program, has three primary goals; (1) to determine the abundance, structure, and distribution of animal communities in the deep-sea Gulf of Mexico; (2) to determine the hydrography and bottom conditions at selected sites within the study area and to relate these to faunal variations; and (3) to measure present levels of hydrocarbon contamination in deep-sea sediments and selected animals. Volume III contains appendices providing a detailed summary of all data collected, which was conducted over five cruises during the first two years of the study.

7298 **The influence of sample size and permeability distribution on heterogeneity measures.** Jensen, J.L.; Lake, L.W. (Heriot Watt Univ. (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 629-637(May 1988).

This study evaluates the influence of sample size on the Dykstra-Parsons and Lorenz measures of heterogeneity. Because either coefficient is determined for a reservoir from a finite number of data, only an estimate is made of the true coefficient. The authors show that, on average, the estimate is less than the true value. They give the relationship between estimate error and number of samples and show how significant errors may arise when too few data are used. The influence of the permeability distribution on heterogeneity measures is also studied. The authors show that a variety of distributions exhibiting different reservoir performance can have the same Dykstra-Parsons coefficient. They propose a heterogeneity measure that includes an indication of the permeability distribution. The new measure requires fewer data than the Dykstra-Parsons estimator. The relationships between the new measure and the Dykstra-Parsons and Lorenz coefficients are given.

## 0203 Drilling And Production

*REFER ALSO TO CITATION(S) 7327, 7359, 7361*

7299 **(ANL/CNSV-TM—186) Recovery and use of waste $CO_2$ in enhanced oil recovery: Proceedings.** Wolsky, A.M.; Brooks, C. (comps.). (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 121p. (CONF-8703302—). NTIS, PC A06/MF A01 - OSTI. Order Number DE89002803/JAW.

From Workshop on recovery and use of waste CO{sub 2} in enhanced oil recovery; Denver, CO, USA (19 Mar 1987).

This report contains eight papers, six of which deal with the use of $CO_2$ for enhanced oil recovery. Of the remaining two articles, one addresses the impact of coal combustion on acid rain and the greenhouse effect, whereas the other evaluates coal combustion in oxygen and in recycled flue gas mixtures. Individual reports were processed separately for the data base. (TEM)

7300 (CERI—1988, pp 20) **Enhanced oil recovery - a North Sea perspective.** Parris, P.A. (Winfrith Petroleum Technology, Dorchester, UK). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

A survey is made of the enhanced recovery of oil in the North Sea. Reservoir characteristics are briefly outlined, and production characteristics are described. In North Sea terms, enhanced recovery means improving the waterflood efficiency, already excellent, or targeting oil trapped in waterflooded regions. Economics of a typical operation mean that enhanced recovery must take place early enough in field life that conventional recovery will pay for the high operating costs of the platform. Total technical potential for enhanced recovery techniques has been estimated at 3-5% of in-place reserves. The applicable technique will depend on the oil price: at current price levels, only polymer flooding and some gas applications look attractive. Success or failure of such a technique is very dependent on the resources devoted to reservoir evaluation, and if there is enhanced recovery potential it should be considered at the design stage. Drilling, well placement, timing, and monitoring are also important in the enhanced recovery strategy chosen. Evaluations are made of polymer flooding, surfactant flooding, and gas injection and their economic/technical applicability, with gas injection being considered as having the best opportunities. For heavy oils, conventional enhanced recovery techniques are extremely difficult in the North Sea environment, and any innovative techniques developed would not be economic at current oil prices. No specific tax incentives are given for enhanced recovery projects in either the UK or Norwegian North Sea; such incentives will be necessary to encourage such projects, particularly if oil prices remain below $20/bbl. 5 refs., 9 figs., 3 tabs.

7301 **(DOE/ET/13077—130) Commerical scale demonstration enhanced oil recovery by micellar-polymer flood: Final report.** Stover, D.F. (Marathon Oil Co., Findlay, OH (USA)). Nov 1988. Contract AC03-78ET13077. 46p. NTIS, PC A03 - OSTI. Order Number DE88001252/JAW.

A contract was executed on September 30, 1976 for the purpose of a commercial-scale test of the Maraflood enhanced oil recovery process. This commercial-scale test, known as the M-1 Project, is located in Crawford County, Illinois. The oil reservoir is the Robinson sandstone, a meandering river deposit with migrating point bars occurring between depths of 750 feet and 1000 feet. This report is the final evaluation of the M-1 Project. A discussion of project operations along with associated problems encountered are presented. A section regarding project performance includes analysis of fluid distribution using streamline maps, a selected pattern area mathematically modeled for performance behavior, and a discussion of actual and predicted performance. Finally, an economic analysis of the M-1 Project is presented. 9 refs., 16 figs., 9 tabs.

7302 **(NIPER—235) Effect of reservior heterogeneities on waterflood and EOR chemical flood performance.** Tomutsa, L.; Knight, J. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1988. Contract FC22-83FE60149. 82p. NTIS, PC A05 - OSTI. Order Number DE88001237/JAW.

Simulations were performed to study the capability of a modified version of the black oil simulator BOAST to handle reservoir heterogeneities of the type encountered in the barrier bar depositional system studied in the geoscience research program being performed for the Department of Energy as project BE1. The cases studied consisted of two-dimensional and three-dimensional simulations of layered reservoirs with different permeability contracts between the layers, different vertical permeability/horizontal permeability ratios and continuous and discontinuous shale layers. Software was developed to show graphically the residual oil saturation in the reservoir grid blocks at selected time intervals during the simulation. BOAST was modified for the residual oil saturation displays as well as for graphical displays of production rates and cumulative production versus time of oil, water and gas. 40 refs., 32 figs., 9 tabs.

7303 **(NIPER—349) Combination alkaline-surfactant flooding: A state-of-the-art review: Topical report.** Lorenz, P.B. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1988. Contract FC22-83FE60149. 29p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004066/JAW.

A review is presented of recent laboratory work reported in the literature on enhanced oil recovery by combination alkaline-surfactant flooding. Consideration is given to surface activity, adsorption, and interaction with divalent cations, along with oil recovery in corefloods. The topics examined are low-acid oils, systematic optimization, ion specificity, mixed alkalis, and injection strategies. It is concluded that alkali-surfactant flooding shows much promise of being cost effective. Areas for further research are indicated. 34 refs., 16 figs., 6 tabs.

7304 **(NIPER—366) Applications of EOR [enhanced oil recovery] technology in field projects: Project BE2, Milestone 3, FY 88: Topical report.** Thomas, R.D.; Pautz, J.F.; Madden, M.P. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Sep 1988. Contract FC22-83FE60149. 27p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004064/JAW.

Trends in the type and number of US enhanced oil recovery (EOR) projects are analyzed for the period from 1981 to 1988. The analysis is based on current literature and news media and the Department of Energy (DOE) EOR Project Database which contains information on almost 1300 projects. The most obvious trend is the steady decline in the number of project starts each year since 1981, which corresponds to the steady oil price decline during that period. The number of new projects started during the past year (mid-1987 to mid-1988) is leveling indicating project starts could have bottomed. Another trend is toward lower risk projects for which reservoir characteristics are the same as those of earlier successful projects. Despite the general lack of enthusiasm for EOR, several innovative techniques such as oil gravity mining, horizontal/slant well drilling, and microbial flooding are still being tried. Despite the temporary setback, long-term EOR prospects remain good, principally because EOR is one of the major sources of new oil reserves and could play a key role in the drive to maintain oil production through the year 2000. 11 refs., 9 figs., 14 tabs.

7305 **Investigation of the rheology and transport of polymers in porous media using network models.** Sorbie, K.S.; Clifford, P.J. (AEE Winfrith, Dorchester, Dorset DT2 8DH (GB)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 1, 37-42(May 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

Polymers have been used in improved oil recovery operations as mobility control agents in surfactant and polymer flooding and in gel treatments. In order to predict the outcome of such processes, it is necessary to have a good understanding of the rheology and transport of polymer solutions in porous media. The rheological behavior refers essentially to the pressure drop/flow rate relationship observed for the polymer solution in the porous medium. It is relatively straightforward to measure rheological properties of bulk polymer solutions such as the viscosity/shear rate behavior or, for elastic fluids, the normal stress differences. However, the pressure drop/flow rate behavior of the polymers in flow through porous media may be either qualitatively quite similar or very different from bulk flow behavior as measured, for example, in a capillary viscometer. In both the rheology and dispersion behavior of polymers in porous media, they see that the phenomenon being observed macroscopically is a result of the interaction between a fluid or molecular property and the stochastic nature of the porous medium at the microscopic level. If one views the porous medium as a network of joined capillaries, then the rheological behavior in each capillary will be quite well defined, e.g. through a single constitutive relationship. In the investigation of hydrodynamic dispersion of polymer and tracer in porous media, the role of the stochastic nature of the medium is clearly evident.

7306 **Second generation copolymers for EOR.** McCormick, C.L. (Dept. of Polymer Science, Univ. of Southern Mississippi, Southern Station Box 10076, Hattlesburg, MS (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 1, 53-58(May 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

In this report, the authors review four types of acrylamide-based copolymers with distinctly different dilute solutions and rheological behavior. Each of these "second generation" systems possesses characteristics which, in theory, should be superior to conventional polymers under certain operational conditions. Type I copolymers are prepared from acrylamide (AM) and sodium-3-acrylamido-3-methylbutanoate (NaAMB). The high molecular weight, viscosity maintenance, and phase stability in the presence of divalent ions make these copolymers especially attractive for mobility control in EOR. Type II copolymers address the problems of entrapment, pore clogging, and shear degradation often encountered with ultrahigh molecular weight copolymers. The copolymers of this type are lower molecular weight than Type 1 but associate in a cooperative manner in semi-dilute solutions to enhance solution viscoscity. In this report, the authors discuss associative polymers of acrylamide/N-alkyl acrylamides which contain low mole percentages of C/sub 8/, C/sub 10/, or C/sub 12/ comonomers. In practice, a third charged comonomer such as carboxylated or sulfonated one, might be necessary to reduce adsorption to reservoir rock. Type III systems are relatively low molecular weight and hyrophibically modified in order to bring about intramolecular micelle-like association in aqueous solution. The aqueous solutions are non-viscous; viscosification occurs upon solubilization of hydrocarbons in the hydrophobic domains. Copolymers of acrylamide with N-propyl diacetone acrylamide are examples of Type III.

7307 **The influence of surfactants on the flow of long bubbles through cylindrical capillaries.** Ginley, G.M.; Radke, C.J. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 1, 141-145(May 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

Foam is a promising fluid for increasing mobility control in underground enhanced oil recovery. An understanding of the fundamentals of foam flow in porous media may be gained by studying the flow of surfactant-stabilized bubble trains in capillary tubes. Thus, by scaling arguments similar to those used for non-Newtonian polymer solution, it appears possible to predict foam-flow behavior in porous media using measurements of and a theory for bubble flow in tubes. This work considers the behavior of a single gas bubble in a capillary with the continuous liquid phase containing surfactant whose concentration is near or above the critical micelle concentration. The authors extend Bretherton's analysis for a clean gas bubble to include the effects of a kinetically hindered, soluble surfactant in the liquid phase on the shape of the bubble, and on the resulting pressure drop across the bubble.

7308 **A pressure-history-matching method for determination of relative permeabilities.** Lal, W.; Brandt, H. (Lawrence Livermore National Lab. (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 651-661(May 1988).

A pressure-history-matching method for determining relative permeabilities was developed and verified in a one-dimensional (1D), analytical/experimental study. The matching method is based on a pressure history induced by injecting a gas (nitrogen in this study) into an incompressible-fluid-saturated porous medium. The analytical model uses relative permeabilities expressed as two-parameter functions of saturation. A parametric study with a finite-difference implicit pressure, explicit saturation (IMPES) solution of the analytical model showed that the relative permeabilities can be determined by matching pressure histories in three steps: (1) match calculated pressure history with measured pressure history during the initial period of 1% of the total injection time, (2) match calculated pressure history with measured pressure history during the final period of 1% of the total injection time, and (3) minimize differences between calculated and measured pressure histories at no fewer than three selected intermediate times. The parametric study also showed that determining relative permeabilities with this pressure-history-matching method requires a knowledge of porosity and specific permeability. Experimental verification compared relative permeabilities of a core determined by the pressure-history-matching method with the relative permeabilities measured by the classic transient-displacement method. The comparison showed errors in the relative permeability of +- 5% for water flow and +30% for gas flow.

7309 **Evaluation of the Wilmington field micellar/polymer project.** Fanchl, J.R.; Carroll, H.B. (Marathon Oil Co. (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 609-616(May 1988).

The Long Beach micellar/polymer pilot in the Wilmington field has been evaluated. Actual recovery efficiency is about two-thirds of coreflood and simulation model estimates. This relatively high recovery efficiency represents a technically successful flood.

Oil recovery was less than optimal, however, because of problems associated with production from an unconsolidated formation and the presence of Desulfovibrio bacteria.

**7310 Experimental studies on the waterflood residual gas saturation and its production by blowdown.** Fishlock, T.P.; Smith, R.A.; Soper, B.M.; Wood, R.W. (U.K. Atomic Energy Authority (GB)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 387-394(May 1988).

Experiments performed on long sandstone cores determined the waterflood residual gas saturation and the mobilization of this trapped gas by reduction of pressure. The trapped gas apparently did not become mobile immediately as it expanded: the gas saturation had to increase appreciably to a critical value for gas remobilization. This new finding has unfavorable implications for possible processes to increase liquids recovery from gas-condensate reservoirs and for enhanced recovery from gas reservoirs invaded by water.

**7311 Evaluation of microbial systems in porous media for eor.** Bryant, R.S.; Douglas, J. (IIT Research Inst./ NIPER (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 489-495(May 1988).

The use of microorganisms to enhance oil recovery has become a technically feasible technology for production from stripper wells (those that produce less than 10 B/D [1.6 m/sup 3//d]). As a result of microbial growth and the production of CO/sub 2/ and/or chemicals, oil recovery can be effectively increased in certain reservoirs with temperatures and salinities hospitable to microorganisms. Research at the Natl. Inst. for Petroleum and Energy Research has led to development of laboratory facilities for evaluating microbial systems for microbial enhanced oil recovery (MEOR) applications. Results from microbial core studies using Berea sandstone have shown that bacteria can vary greatly in their ability to recover residual oil after waterflooding, giving from 7.5 to 71% recovery efficiency. The type of core encapsulation did not affect oil recovery. Variations in rock permeability from 134 to 1,920 md indicated that some microorganisms may exhibit a better recovery efficiency in lower-permeability cores. The results also show that gas production by microorganisms is not the only factor affecting oil recovery; some bacteria that produce surfactants but no gas could provide equally efficient additional oil recoveries. Likewise, the type of surfactant also makes a difference; two species that produce surfactants can vary in recovery efficiency. Another contributing mechanism to microbial oil mobilization may be by increasing areal sweep efficiency from microbial growth. A comparison of oil recovery efficiencies between microorganisms using a medium-to-light-gravity oil (Delaware-Childers) and two heavy oils (Wilmington, CA, and Chaffee, CA) indicates that MEOR may be effective for heavy oils as well as light oils. Correlations are presented between the recovery efficiency of a particular microbial species and its ability to mobilize crude oil in etched-glass micromodels.

**7312 Effects of reservoir heterogeneity on chemically enhanced oil recovery.** Gupta, A.D.; Pope, G.A.; Sepehrnoori, K.; Shook, M. (Standard Alaska Production Co. (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 479-488(May 1988).

A three-dimensional (3D), multiphase, multicomponent micellar/polymer flooding simulator has been used to investigate the process performance under different conditions of reserovir heterogeneity (stratification) and mobility ratios. The significance of crossflow has been studied by relating chemical flood recoveries to the effective length-to-thickness ratio and the transverse dispersion number of the reservoir. A long-standing question in micellar/polymer flooding concerns whether small, high-concentration chemical slugs are preferred to large lower-concentration slugs. This aspects of slug size vs. slug concentration has been studied in 3D in the presence of heterogeneity. Finally, chromatographic separation of surfactant and alcohol has been investigated and discussed. It is found that a salinity gradient can be tailored to minimize this separation tendency and that this in fact is the single most important factor, even when compared with adsorption and partitioning. This is a highly favorable result that can and should be exploited to improve the practical design of micellar/polymer floods.

**7313 Mechanisms of foam generation in glass-bead packs.** Ransohoff, T.C.; Radke, C.J. (Xoma, Berkeley, CA (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 2, 573-585(May 1988).

The fundamental, pore-level mechanisms of foam generation are investigated in monodisperse bead packs. First, direct visual observations identify the following generation mechanisms: lamella leave-behind, gas-bubble snap-off, and lamella division. Then, to ascertain the relative importance of these mechanisms, quantitative experiments are pursued on the role of bead-pack permeability (bead sizes from 0.25 to 1 mm [0.01 to 0.04 in]), gas-phase velocity (0.001 to 0.8 cm/s [0.0004 to 0.3 in./sec]), gas-phase fractional flow (0.60 to 1.0), permeability variations, and surfactant type [sodium dodecyl benzene sulfonate (SBDS), sodium dodecyl sulfate (SDS), Chevron Chaser SD1000, and Suntech IV 1035]. The authors discover a critical velocity, above which a "strong" foam is generated and below which only "weak" foam is formed. The snapp-off mechanism is the primary mechanism responsible for the formation of the strong foam. A simple model, based on the concept of a "germination site," is developed to predict the onset of snap-off at higher gas velocities. New experimental data obtained in the homogeneous glass-bead packs for the critical capillary number necessary to form a strong foam are in excellent agreement with the proposed germination-site model.

**7314 Mobility of CO/sub 2/-foam in porous rocks.** Lee, H.O.; Heller, J.P. (New Mexico Petroleum Recovery Research Center, New Mexico Institute of Mining and Technology, Socorro, NM (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 1, 136-140(May 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

For a miscible displacement at the required reservoir conditions, carbon dioxide must exist as a dense fluid (in the range 0.5 to 0.8 g/cc). Unfortunately, the viscosity of even dense CO/sub 2/ is in the range of 0.03 to 0.08 cp, no more than one twentieth that of crude oil. When CO/sub 2/ is used directly to displace the crude, the unfavorable viscosity ratio produces inefficient oil displacement by causing fingering of the CO/sub 2/, due to frontal instability. In addition, the unfavorable mobility ratio accentuates flow non-uniformities due to permeability stratification or other heterogeneities. The mobility of CO/sub 2/ in porous rock can be decreased by containing it in a foam-like dispersion. Such CO/sub 2/-foams have been proposed as a useful injection fluid in enhanced oil recovery. A critical literature review on general foam rheology is given elsewhere. The foam flooding method modifies the flow mechanism by changing the structure of the displacing fluid at the pore level. The purpose of this paper is to demonstrate the laboratory measurement of the mobility of CO/sub 2/-foam at different flow rates, carrying out steady-state experiments using real rock samples as the porous media. The mobility of CO/sub 2/-foam is greatly dependent on the single-phase permeability of the rock sample. This is shown by comparison of mobility measurements made with Rock Creek and with Berea sandstones. In addition to presenting the results of these measurements, the operation of the apparatus, the conduct of the experiment and the testing of several features of surfactant suitability at reservoir conditions are briefly discussed.

## 0204 Processing

*REFER ALSO TO CITATION(S) 7195, 7205, 7340, 8563*

**7315 (FRNC-TH—3346) Development of a dynamic micropilot plant for hydrotreatment of heavy petroleum products and hydroconversion of an asphalt and a Safaniya vacuum residue.** Menez, D. (Aix-Marseille-3 Univ., 13 - Marseille (France)). Sep 1986. 168p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756038/ JAW.

The valorization of heavy petroleum cuts is examined in this thesis. After a bibliographic review on thermal processes, commercial processes (partial oxidation, cracking, visbreaking) are described. Basic studies on asphalt reactivity in presence of a hydrogen donor (tetralin) and thermal stability of tetralin are also re-

viewed. Experimental tests are realized on behavior of tetralin in thermal hydroconversion and conversion of heavy petroleum products in presence of hydrogen donor (tetralin) or hydrogen transfer agent (pyrene). Results show a better conversion, however limited because asphaltenes are not hydrogenated. Optimum temperature is about 450/sup 0/C, below conversion is limited, above coke is formed. Conversion products and coke precursors are stabilized by hydrogen donors or hydrogen transfer agents.

7316 **(KFK-PEF—43) Desulfurisation of liquid petroleum and petroleum fractions by oxidation with excited oxygen.** Suhr, H.; Becker, E.; Koteschke, B.; Nauenburg, K.; Schmid, H.; Iacocca, D.; Gil, J.; Ramirez, J.; Ropero, M.; Sanchez, N. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Organische Chemie). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Tuebingen Univ. (Germany, F.R.). Inst. fuer Organische Chemie). Aug 1988. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755983/JAW.

A method to desulfurize high-boiling oil fractions and residual oils by oxygen plasma treatment was developed. It involves the oxidation of the sulfur compounds and the separation of a new phase with a higher specific gravity. The process was tested for representative compounds, simple mixtures and mineral oil fractions. (orig.) With 24 figs.

7317 **(NIPER—379) Preliminary thermodynamic studies on the hydrodenitrogenation of indole.** Steele, W.V.; Chirico, R.D. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Dec 1988. Contract FC22-83FE60149. 14p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89000708/JAW.

This report, detailing preliminary thermodynamic calculations on the hydrodenitrogenation (HDN) of indole, shows that thermodynamic limitations exist in the reaction network. The first step in the reaction scheme (indole → indoline) is a reversible reaction in the temperature range of interest, favored by low temperature. At 473 K (200{degree}C) 21 atmospheres of hydrogen is needed to obtain a 50/50 mole percent mixture of indole and indoline: at 573K (300{degree}C) 136 atmospheres of hydrogen is needed to obtain a 50/50 mole percent mixture of indole and indoline. The results of the thermodynamic analysis are in substantial agreement with the equilibrium data available in the literature. The thermodynamic data are used to help elucidate another study in the literature in which several different catalysts were compared. The results show that for a given catalyst, increasing the hydrogen pressure fails to promote the hydrogenolysis reaction relative to the hydrogenation equilibrium; increasing the temperature does promote hydrogenolysis. The relatively large C-$NH_2$ bond dissociation energy in 2-ethylaniline compared to 2-ethylcyclohexane means that the major pathway to HDN using present technology is via ring saturation. However, if catalysts can be found to selectively cleave the C-$NH_2$ bond in 2-ethylaniline, significant hydrogen saving can result. 20 refs., 4 figs., 2 tabs.

7318 **(PB—88-249867/XAB) Refinery process-heater NOx control by staged combustion air lances.** Hunter, S.C.; Hall, R.E. (KVB, Inc., Irvine, CA (USA)). 1988. 7p. (KVB—72-P-322). NTIS, PC A02/MF A01.

Pub. in Jnl. of Engineering for Gas Turbines and Power, Vol. 110, 185-189(Apr 1988). See also PB—84-229640.

This paper gives results of tests of a natural-draft petroleum-refinery crude-oil process heater, modified to reduce oxides of nitrogen (NOx) emissions by installing staged-combustion air lances. Baseline nitric oxide (NO) emissions firing refinery gas before modification were measured to be 100-125 ppm by volume, dry, corrected to 3% oxygen. Staged-combustion air lances bypassed combustion air around the burners to achieve staged combustion. With the modification, an average reduction of 64% in NO emissions was observed over a 30-day test period, with NO emissions of 25-50 ppm, depending on the excess air.

7319 **(PB—89-116313/XAB) Emergency Planning Guidance Notes: Refinery Emergency Planning.** Bridgens, W.A.G.; Cassarino, S.; Marlier, G.; Clark, R.; Veldhuijzen, R. (Concawe, The Hague (Netherlands)). 1988. 51p. (CONCAWE—6/88). NTIS, PC E04/MF A01.

The sixth Guidance Note in the series being issued by CONCAWE on the general subject of major hazards with specific reference to implementation requirements of the Seveso Directive is described here. The overall purpose of these Notes is to provide guidance to CONCAWE contributing companies on various aspects of the assessment and control of major hazards. The Notes may also assist National Regulatory Authorities in their contacts with the Petroleum Industry. The Guidance Note Refinery Emergency Planning describes emergency organization specifically for oil refineries. The general principles also apply to smaller oil installations such as marketing terminals. A framework for emergency organization is outlined including descriptions of key responsibilities, and some typical actions are highlighted for various emergency cases. The need for training in emergency roles is emphasized and rehearsals of credible event exercises are recommended to ensure readiness.

## 0205 Products And By-products

*REFER ALSO TO CITATION(S) 7357, 7389, 8057*

7320 **(AD-A—198197/6/XAB) Aviation-fuel lubricity evaluation.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Jul 1988. 212p. (CRC—560). NTIS, PC A10/MF A01.

Fuel-system components have experienced problems with the slipperiness or lubricity of the fuel back to the early 1960's. As a consequence of the level of refinement necessary for the PWA 523 fuel (now designated MIL-T-38219 grade JP-7) to obtain its high-temperature stability, many of the polar compounds contributing to lubricity had been removed, resulting in abnormal hydraulic fuel-pump wear. A lubricity-enhancing compound was developed (PWA 536) to eliminate the wear problem. High-pressure piston-type fuel pumps were one of the first parts of the engine fuel system to exhibit problems related to fuel properties. One early problem manifested itself as corrosion of silver-plated slipper pads and was related to carryover of residual-chlorides fuel. Fuel controls were another part of the engine fuel system susceptible to fuel properties. Lack of lubricity agents caused fuel control sliding servo valves to stick.

7321 **(AD-A—198678/5/XAB) Sterling Technology ultra-pure filtered diesel fuel. Final report, April 1984-April 1988.** Adams, E.C. (Army Tank-Automotive Command, Warren, MI (USA)). May 1988. 32p. (TACOM-TR—13376). NTIS, PC A03/MF A01.

This report details testing done on ultra-pure filtered diesel fuel and unfiltered diesel fuel. Several barrels of filtered fuel, shipped from the manufacturer--Sterling Technology, Inc., Jacksonville, Florida--were tested using the 690-in. Deutz F-8L-413A Air Cooled V8 Engine. No significant difference was found, but due to a delay in starting the tests, it was suspected that some deterioration might have occurred in the fuel. The objective was to investigate the possible benefits of the ultra-pure filtered diesel fuel in power improvement and reduction of exhaust smoke.

7322 **(AD-A—198743/7/XAB) Evaluation of corrosion inhibitors as lubricity improvers. Interim report No. 2, 16 February 1987-15 February 1988.** Biddle, T.B.; Edwards, W.H. (Pratt and Whitney Aircraft, West Palm Beach, FL (USA). Government Products Div.). Jul 1988. 163p. (PW/GPD-FR—19031-2). NTIS, PC A08/MF A01.

The technical effort described was directed as evaluating the corrosion inhibitors (CI) currently approved under the MIL-I-25017D qualified products list (QPL). The thrust of the effort focused on the following: (1) establishment of relative effective concentrations for approved CI, (2) generation of working curves to profile CI performance in jet fuels, (3) development of an approach for incorporating a lubricity requirement into MIL I-25017, (4) refinement of the reverse-phase high-performance liquid chromatog-

raphy (RPHPLC) method for determining CI content in jet fuels, (5) determination of applicability of the RPHPLC to WPL CI, and (5) generation of an RPHPLC spectral library of WPL CI in JP-4. IPC-4410 was found to be among the most effective CI at improving the lubricity properties of jet fuels, while TOLAD 249 was shown to be the least effective. Pratt & Whitney found that a requirement for lubricity enhancement could easily be incorporated into MIL-I-25017 with no significant effect on other criteria used in qualifying a canadidate CI. The RPHPLC method for determining levels of CI in jet fuel was found to be applicable to all 15 QPL CI.

7323 **(AD-A—198782/5/XAB) Technology for use of variable-quality fuels. Interim report, October 1984-September 1987.** Bowden, J.N.; Yost, D.M.; Montemayor, A.F.; Stavinoha, L.L. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1987. 82p. (BFLRF—239). NTIS, PC A05/MF A01.

This program was intended to determine the specification properties of diesel fuel that can be varied and relaxed with little or no performance or handling penalties by using modified bench and engine tests. Specially blended test fuels were used that had selected properties outside of specified limits in Federal Specification VV-F-800D, Fuel Oil, Diesel, Grade DF-2. The properties investigated were cetane number, viscosity, distillation-temperature limits at 90% recovered and end point, accelerated stability values, and carbon residue on 10% bottoms. Cold-starting tests to investigate the effect of fuel cetane numbers and viscosities were conducted with engines common to the Army inventory as follows: Detroit 6V-53T, Continental LDT-465-1C, Cummins NHC-250, and General Motors 6.2L. The effect of higher 90% distillation and end-point temperatures than specified was investigated using a Petter model PH1W single-cylinder diesel engine.

## 0206 Health And Safety

*REFER ALSO TO CITATION(S) 7319*

7324 **(PB—89-116321/XAB) Emergency Planning Guidance Notes: Content of Emergency Plans, Planning for Mutual Aid.** Bridgens, W.A.G.; Cassarino, S.; Marlier, G.; Clark, R.; Veldhuijzen, R. (Concawe, The Hague (Netherlands)). 1988. 31p. (CONCAWE—5/88). NTIS, PC E03/MF A01.

These are two of a series of Guidance Notes being issued by CONCAWE on the general subject of major hazards with specific reference to the implementation of the requirements of the Seveso Directive. The overall purpose of these Notes is to provide guidance to CONCAWE contributing companies on various aspects of the assessment and control of major hazards. The Notes also assist National Regulatory Authorities in their contacts with the Petroleum Industry. The Guidance Note on Content of Emergency Plans assists in defining those items which should be addressed in On-site Emergency Plans as well as outlining a recommended format for the emergency manual. In addition, some guidelines for the content of off-site Emergency Plans are described. The Guidance Note on Planning for Mutual Aid is to assist in preparing plans to harness the combined resources of plants within a region in the event of an emergency at any one site.

## 0207 Marketing And Economics

*REFER ALSO TO CITATION(S) 7300*

7325 **(AD-A—199072/0/XAB) Short-term planning and forecasting for petroleum. Master's thesis.** Elkins, R.D. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 70p. NTIS, PC A04/MF A01.

The Defense Fuel Supply Center (DFSC) has, in recent past, been unable to adequately forecast for short-term petroleum requirements. This has resulted in inaccurate replenishment quantities and required short-notice corrections, which interrupted planned resupply methods. The relationship between the annual CINCLANTFLT DFM budget and sales from the the Norfolk Defense Fuel Support Point (DFSP) is developed and the past sales data from the Norfolk DFSP is used to construct seasonality indices. Finally, the budget/sales relationship is combined with the seasonality indices to provide a new forecasting model. The model is then compared with the current one for FY-88 monthly forecasts. The comparison suggests that the new model can provide accurate, timely requirements data and improve resupply of the Norfolk Defense Fuel Support Point.

7326 (CERI—1988, pp 2) **The short and medium term oil market: a European perspective.** Gibson-Smith, C. (BP International Limited, London). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

The changes in the European oil market are discussed, taking into account the significant changes in oil consumption and supplies. Future perspectives for this market are dependent on the outlook for North Sea oil production, protection of domestic coal industries and the role of natural gas. Production figures outlined in this paper suggest British output has peaked and will decline, but such decline could be offset by Norwegian output. Excess production from OPEC will not be absorbed easily over the short term, and a key factor in determining oil prices is OPEC's willingness and ability to restrain output.

7327 (CERI—1988, pp 11) **Enhanced oil recovery outlook - economic prospects for EOR in Canada.** Moore, J.S. (Amoco Canada Petroleum Co. Ltd.). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

Existing studies have shown that application of enhanced recovery techniques to conventional reservoirs in Canada could add reserves of up to 3 billion bbl; for heavy oil reservoirs, the potential addition to reserves is much greater. This presentation gives one oil company's views on the prospects for low-recovery-level and heavy oil reservoirs as targets for enhanced recovery, with respect to current fiscal policies. Amoco Canada's activities in developing some of those prospects, notably in heavy oil reservoirs, are outlined.

7328 (CERI—1988, pp 9) **Powering the Pacific - past, present and future.** Reed, R.G. III. (Pacific Resources, Inc., Honolulu, HI). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

The countries of the Asia-Pacific region are characterized by high economic growth, and a dependence on oil imports. Petroleum management policies among countries of this region are briefly mentioned, and petroleum demand compared. Alternatives to petroleum are increasing in that region, with gas, nuclear, and hydroelectric energy becoming more important. Marketing of petroleum necessitates careful consideration of local markets. 4 figs.

7329 **(CERI—1988) 7th CERI International Oil and Gas Markets Conference proceedings.** (Canadian Energy Research Institute, Calgary, Alberta). 1988. vp. (CONF-8809206—; CE—02029). Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN.

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

A conference was held to examine various aspects of the marketing of oil and gas in Canada and the rest of the world. Papers were presented on energy policy, exploration opportunities, Canada-USA oil and gas trade, the oil/gas industry and markets in various countries and regions, and the outlook for enhanced recovery. Separate abstracts have been prepared for 18 papers from this conference.

7330 **(CRIE-Y—87006) Oil policy of Saudi Arabia and world oil market.** Hatsukade, Yoshiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 19p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755731/JAW.

In order to clarify the future trends of Saudi oil policy and its implications for the world oil market based on the features of Saudi oil business and development of the oil policy, the framework of Saudi oil industry after nationalization in 1978 and the role of ARAMCO, and the development of Saudi oil policy and its oil operations since the Second Oil Crisis through 1980's were analyzed. ARAMCO has maintained the feature of an independent enterprise in Saudi after nationalization and the significant role for Saudi crude oil trade with the majors, so that Saudi had a unique feature in OPEC giving priority to government enterprises. Since Saudi held fast its price policy to keep the OPEC price, the volume of crude oil trade with the majors varied widely according to circumstances, so Saudi seemed to behave as a swing producer. Consequently, in recent years Saudi has been driven to shift to a new flexible price policy to secure a stable crude oil outlet. (2 figs, 1 tab)

7331 **(DOE/PE/79013—T1) OPEC and lower oil prices: Impacts on production capacity, export refining, domestic demand and trade balances.** Fesharaki, F.; Fridley, D.; Isaak, D.; Totto, L.; Wilson, T. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Dec 1988. Contract FG01-87PE79013. 153p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89005002/JAW.

The East-West Center has received a research grant from the US Department of Energy's Office of Policy, Planning, and Analysis to study the impact of lower oil prices on OPEC production capacity, on export refineries, and petroleum trade. The project was later extended to include balance-of-payments scenarios and impacts on OPEC domestic demand. As the study progressed, a number of preliminary presentations were made at the US Department of Energy in order to receive feedback from DOE officials and to refine the focus of our analysis. During one of the presentations on June 4, 1987, the then Director of Division of Oil and Gas, John Stanley-Miller, advised us to focus our work on the Persian Gulf countries, since these countries were of special interest to the United States Government. Since then, our team has visited Iran, the United Arab Emirates, and Saudi Arabia and obtained detailed information from other countries. The political turmoil in the Gulf, the Iran/Iraq war, and the active US military presence have all worked to delay the final submission of our report. Even in countries where the United States has close ties, access to information has been difficult. In most countries, even mundane information on petroleum issues are treated as national secrets. As a result of these difficulties, we requested a one-year no cost extension to the grant and submitted an Interim Report in May 1988. As part of our grant extension request, we proposed to undertake additional tasks which appear in this report. 20 figs., 21 tabs.

7332 **(IEE—SR-198) Present status and prospects of North Sea (NS) petroleum production.** Hasegawa, Noboru. (Institute of Energy Economics, Tokyo (Japan)). May 1988. 186p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755743/JAW.

This paper describes the present status and prospects of the NS oil field production, which is escalating. The 1986 production exceeded 3.5 million barrels per day, accounting for 8% of the total production of the free world. The NS field broke the ice in reducing crude oil prices. The quick oil price drop in early 1986 was led by Brent Crude Oil, a representative of the NS field. Brent's forward-delivery price serves as an important index in determining crude oil prices. Most of NS oil is exported. The NS oil price drop shocked the Norwegian economy. NS oil production either complies with demand or is reduced in accordance with the OPEC guideline. Production costs (capital plus running costs) are 11 dollars per barrel in oil-producing fields and 16 dollars per barrel in fields being developed. Exploration has stagnated but is still carried out with high efficiency. This has enabled large fields to be discovered. Production is expected to increase from 3.5 million barrels per day at present to 3.7 million barrels per day in 1989, reaching its peak. Then, production will stay about 3.5 million barrels per day until somewhere around 1993. Reserve that has been discovered exceed 15 billion barrels in Great Britain and 10 billion barrels in Norway. (36 figs, 70 tabs)

7333 **(IEE-SR—199) Development and application of global petroleum flow model. Test calculation of oil products supply capacity of Pacific rim area to Japan.** (Institute of Energy Economics, Tokyo (Japan)). Jun 1988. 86p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755744/JAW.

Development and application of a global petroleum model were discussed in this paper. In the model, the optimum physical distribution and oil refining patterns in the international oil market were calculated through a linear programming. Ten principal areas in oil-marketing were choosen and six crude oil types, light to heavy, were introduced. The refining flow was extrapolated from the all Japan oil refining model, and was cuppled to oil refinery models in each area. The flow model was applied to a test calculation of oil products supply capacity to Japan of five Pacific rim areas; East Asia, South-east Asia, Oceania, Middle East, and the west coast of North America. Gaasoline supply capacity to Japan would reduce from two hundred thosand Bbl/d in 1985 to one hundred thousand Bbl/d in 1991, when nine tenth of the gasoline would be from South-east Asia and oceania, no supply from Middle East. Middle distillate would also reduce greatly. There would be little change on naphtha and heavy oil. Middle East area has no reserve capacity for gasoline. If crackers to produce more middle distillate are introduced, marginal export capability of middle distillate in the area would increase. (28 figs, 36 tabs)

7334 **(IEE-SR—200) Survey on trends in the European oil situation.** (Institute of Energy Economics, Tokyo (Japan)). Jun 1988. 138p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755745/JAW.

A survey on trends in the European oil situation is discussed in this paper. The oil consumption in European countries was twelve million bbl/d in 1986; a 17% decrease to the total of 1979 is due to the conversion of heating fuel use to other heat sources. From 1986 on, however, the total consumption is increasing. The rate of increase in 1988 is estimated to be 1%. Although the oil refining industry in the EC area was active in 1986, there remained surplus of heavy oil and shortage of middle distillate. The operation rate and profitability of the industry were improved. Oil product import increased in the U.S.A. and Japan. The petroleum oversupply that began in 1980 has promoted relaxation of regulation and liberalization in oil distribution. The European Continent has a pipeline network of five thousand kilometer and storage tank capacity for half a year consumption. Oil retailing in supermarkets accounts for 7.2% of the whole European market. The U.S.S.R. suffers in oil reserves and oil production technology, consequently, hopes to advance into the Persian Gulf area and to obtain the cooperation of Japan. Norway's oil and gas reserves account for 41% and 48%, respectively, of the total reserves in western Europe. The North Sea oil field of the U.K. deprived market share of OPEC, however, faces decline of production because of low prices. (20 figs, 81 tabs)

## 0208 Waste Management

7335 **(PB—89116024/XAB) Technology-evaluation report, site program demonstration test, Shirco Infrared Incineration System, Peak Oil, Brandon, Florida. Volume 2.** Rosenthal, S.; Wall, H.O. (Environmental Protection Agency, Cincinnati, OH (USA). Risk Reduction Engineering Lab.). Sep 1988. 405p. (EPA—540/5-88/002B). NTIS, PC A18/MF A01.

A Shirco Infrared system used for a removal action at a PCB-containing oil-refining waste site in Brandon, Florida (a suburb of Tampa) was evaluated. The evaluation included a determination of toxics in the material being decontaminated as well as all the effluent streams such as ash, air emissions, and waste water. These streams were analyzed for heavy metals, organics, dioxins, and furans, as well as NOx, and inorganic acids. Leaching tests were performed on the ash. The results indicated that the PCB was

reduced from 5 to 100 ppm to less than 1 ppm in the ash, which was the purpose of the removal action. Although research had indicated that the lead compounds in the ash would become insoluble because they would be complexed with carbon, the ash could not be considered non-leachable based on the EP toxicity tests.

## 0209 Environmental Aspects

*REFER ALSO TO CITATION(S) 7254, 7294, 7318, 8094, 8095, 9151, 9186, 9294, 9342, 9386*

7336 **(C—EE-105) Mesoscale application and testing of an oil spill demulsifying agent and Elastol.** Bobra, M.; Kawamura, P.; Fingas, M.; Velicogna, D. (Consulthem, Ottawa, Ontario (Canada); Environment Canada, Ottawa, Ontario). 1988. 50p. (MICROLOG—88-05251). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Applicators suitable for mesoscale use were developed for the oil spill treating agents Elastol and Brand M Demulsifier/Demoussifier. The distribution characteristics of each applicator were tested and optimized. Experiments were conducted in the laboratory to determine the effectiveness of the treating agents when applied by these systems. The results are similar to those of previous studies and showed that the applicators could effectively distribute the agents onto oil spilled on water. The applicators were used during four days of tests performed in a large scale wave basin. The results from these tests are discussed. Slicks treated with the demoussifier had lower water content. Oil recoverablility, as determined by use of a skimmer, was decreased by demoussifier treatment, but this could be remedied by adding Elastol. The application of Elastol rendered oil viscoelastic and thus enhanced oil recoverability by a skimmer. A slick treated with 4,000 ppM Elastol proved to be insufficiently thick to propagate burning. 2 refs., 14 figs., 4 tabs.

7337 **(EGG-M—88445) Annular centrifugal contactors as rapid oil-water separation devices.** Meikrantz, D.H.; Bourne, G.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 11p. (CONF-8811122—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89005139/JAW.

From 13. annual environmental quality R and D symposium; Williamsburg, VA, United States (16 Nov 1988).

The results of preliminary test to apply devices known as annular centrifugal contactors to the rapid separation of oil-water mixtures are presented. Separation efficiencies of oil from water of >99% have been demonstrated on both light and heavy oils. Equilibrium within the separating zone of the contractor is reached within seconds. Dynamic testing in which water to oil flow ratios of 1:5 and 5:1 have been conducted without loss of performance. The laboratory scaled contactors tested have total throughout of 80 cc/min. The design and construction of larger devices with total throughputs of hundreds of gallons per minute is feasible. Such contactors would be compact units capable of allowing rapid recovery from a broad range of hydrocarbon spills on waterways. The efficiency of these contactors is such that water discharged can be returned directly to the environment. Recovered hydrocarbons may be useful without further refinement. 4 refs., 1 fig., 2 tabs.

7338 **(EPS—8711) Summary of the spill events in Canada, 1974-1983.** Beach, R.A.; Cloutier, G. (Environnement Canada, Ottawa, Ontario. Conservation et Protection). 1987. 54p. (MICROLOG—88-03035). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An analysis of ten years of data from a database for all oil and non-oil spills reported to Environment Canada, 1974 through 1983, is presented in this paper. An appendix presents the results for each year. A statistical analysis of the results reveals the following significant patterns and trends. The total number of events reported from 1974 to 1983 was 21,587, and the number of events per year increased until 1980, then decreased. This rise and fall in events reported is a reflection of the actual number of spills occurring in Canada. The source with the greatest spill tonnage reported was industrial plants, and the source with the most events reported was production fields (mines and wells). Events and tonnages spilled in marine events remained constant throughout the period; tank truck road accidents decreased over the period. Pipeline spills decreased sharply in 1982 and 1983, and production field pipe leak events decreased, but tonnage spilled remained constant. The proportion of events reported that involved chemicals (non-oils, but excluding salt water) increased from 10% in 1974 to 25% in 1983. The most important non-oils spilled were saline water, sewage, and industrial waste. In the industrial plant category, overflows decreased over the period, while discharges (accidental or intentional) increased. For oils, the most frequently spilled material was crude oils. The sector most responsible for spills was the petroleum sector, with 58% of all spill events; the next most important was the transport sector, with 16%. Includes glossary. 3 figs., 14 tabs.

7339 **(LA—8804) The effects of crude oil and the dispersant Corexit 9527 on the vegetation of a Nova Scotian saltmarsh: impacts after two growing seasons.** Crowell, M.J.; Lane, P.A. (Lane (P.) and Associates Ltd., Halifax, Nova Scotia (Canada)). 1988. 98p. (MICROLOG—88-04813). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The effects of experimental applications of Alberta crude oil on three zones of a Nova Scotia salt marsh over two growing seasons, and the impact of application of a dispersant to one of the zones, were investigated in this study. These effects were monitored using a number of parameters, including plant growth, stem density, biomass, species cover, and soil profile changes. These data revealed that there was considerable variation in the sensitivity of the zones to the oil treatment. There was little effect on the creek edge zone; the midmarsh zone, by contrast, was severely impacted by the oil in 1986 and displayed relatively little recovery during the 1987 season. The large differences in toxicity between the creek edge and midmarsh zones appeared to be related to the inability of Spartina alterniflora, the dominant midmarsh species, to tolerate the additional stress of oil toxicity. Oil impacts in the high marsh zone were intermediate between those of the other 2 zones. Biomass and species cover data revealed similar successional trends for the 3 zones following application of oil or dispersant. Annual species increased in abundance in plots where interspecific competition had been reduced by oil- or dispersant-induced mortality of Spartina. Based on current rates of recovery, the creek edge zone recovered from oiling within one year of treatment and will probably recover from the dispersant treatment within 2 years. The high marsh zone will probably require 3-4 years for full recovery, while the midmarsh zone will probably require at least 5 years. 34 refs., 31 figs., 11 tabs.

7340 **(PB—88-248810/XAB) Worker exposure to polyaromatic hydrocarbons at selected petroleum-refinery process units, Chevron U.S.A. Inc. Refinery, El Segundo, California, January 15-17, 1980. Phase 3 survey report No. 4.** Cox, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1980. 44p. (IWS—90.14). NTIS, PC A03/MF A01.

Worker exposures to 23 individual or groups of polyaromatic hydrocarbons (PAH) and azo-heterocyclic compounds were determined at Chevron U.S.A. Inc. Refinery, El Segundo, California, on January 15-17, 1980. Area and personal samples were collected in the fluid catalytic cracker (FCC) and delayed coker units using a silver-membrane filter followed by Chromosorb 102. Upwind samples at the refinery boundary line were also collected. Samples were analyzed by gas chromatography and mass spectrometry. Of 39 samples from the two process units, 38 had detectable quantities of at least 4 of the 23 PAHs (or groups of PAHs). Cumulative PAH concentrations for individual samples ranged from nondetected to 145.7 micrograms per cubic meter (CuM). Upwind boundary

samples averaged 2.7 micrograms/CuM. Personal samples at the FCC unit generally were more than 5 times greater than those from the delayed coker. Two total mass area samples averaged in the FCC unit also were much higher than those collected in the coker.

7341 **(PB—88-870258/XAB) Oil-spill recovery: oil booms and skimmers. January 1971-October 1988 (Citations from the US Patent data base). Report for January 1971-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 56p. NTIS PC N01/MF N01.

This bibliography contains citations of selected patents concerning booms, skimmers, and skimming techniques for oil spill recovery. Selected patents include oil absorbent materials, dispersants, floating booms, methods and equipment for oil-spill containment and collection, marine barriers, cryogenic beach cleaners, microbial materials, and ultrasonic oil removal. Citations concerning oil-water separation for non-oil spill recovery applications are excluded and examined in a separate bibliography. (Contains 127 citations fully indexed and including a title list.)

7342 **(PB—88-870613/XAB) Oil/water separation. January 1971-October 1988 (Citations from the US Patent data base). Report for January 1971-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 61p. NTIS PC N01/MF N01.

This bibliography contains citations of selected patents concerning oil/water separation methods and equipment. Selected patents include gravity separators, centrifugal filters, coalescers, emulsion separation, vortex separators, vibration separation, and siphons. Patent designs for content monitor/control systems, crude oil/water and fuel oil/water separators, and polymeric materials for removing oil from water are presented. Patents concerning booms and skimmers for oil-spill recovery are excluded and examined in a separate bibliography. (Contains 121 citations fully indexed and including a title list.)

7343 **(PB—89-103253/XAB) Coastal-Wave Statistical Data Base. Volume 1. Executive summary. Final report.** Earle, M.D.; Eckard, J.D. (MEC Systems Corp., Manassas, VA (USA)). Apr 1988. 17p. NTIS, PC A03/MF A01.

See also PB—89-103261.

A Coastal Wave Statistical Data Base (CWSDB) for the U.S. west coast was developed to rapidly and efficiently provide ocean-wave statistics based on high-quality ocean-wave measurements for applications of the Minerals Management Service (MMS) Pacific OCS Region. The data base operates on a super-microcomputer system in the Los Angeles offices of the Pacific OCS Region. The CWSDB includes wave information through 1986 for fifty-eight locations off the west coast of the continental U.S.

7344 **(PB—89-103261/XAB) Coastal-wave statistical data base. Volume 2. Description, application, and user's guide. Final report.** Earle, M.D.; Eckard, J.D. (MEC Systems Corp., Manassas, VA (USA)). Apr 1988. 97p. NTIS, PC A05/MF A01.

See also PB—89-103253.

A Coastal Wave Statistical Data Base (CWSDB) for the U.S. west coast was developed to rapidly and efficiently provide ocean-wave statistics based on high-quality ocean-wave measurements for applications of the Minerals Management Service (MMS) Pacific OCS Region. The data base operates on a super-microcomputer system in the Los Angeles offices of the Pacific OCS Region. The CWSDB includes wave information through 1986 for fifty-eight locations off the west coast of the continental U.S. This volume of the Final Report describes work performed during the project, describes the wave information incorporated into the data base, and includes a User's Guide with instructions for operating the data base.

7345 **(PB—89-115984/XAB) Field guide to the application of dispersants to oil spills.** Gillot, A.; Aston, G.H.R.; Bonanzinga, P.; Rudd, J.K.; Mason, M.J. (Concawe, The Hague (Netherlands)). 1988. 73p. (CONCAWE—2/88). NTIS, PC E04/MF A01.

Color illustrations reproduced in black and white.

The objective of the field guide is to inform on techniques presently available for applying dispersants, so that the reader is in a better position to decide on the system of application to ensure best effect. The emphasis is not whether the dispersant option is the best response in a given oil-spill situation, but rather to demonstrate how best to use dispersants once a decision to use them has been taken. However, it is important to appreciate technical limitations of dispersants and these are explained. In addition to advice on the application techniques themselves, the guide contains information of practical significance to oil spill response teams on dispersants, oil weathering, monitoring techniques, tactics and logistics, costs of treatment, regulations and safety considerations.

7346 **(PB—89107726/XAB) Environment effects of oil spill combustion.** Evans, D.; Mulholland, G.; Gross, D.; Baum, H.; Saito, K. (National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Fire Research). Sep 1988. 52p. (NISTIR—88/3822). NTIS, PC A04/MF A01.

Experimentation and analysis were performed to quantify the combustion of crude oil on water. The burning behavior of three crude oils -- ALBERTA SWEET, LA ROSE, and MURBAN, were studied using 1.2-m-diameter pool burns; in 0.6-m-diameter pool fires using ALBERTA SWEET, combustion products were collected for extensive chemical analysis. The analysis showed that about 10% of the crude oil was converted to smoke in the combustion process. The CO concentration was a factor of 25 lower than the primary gaseous product $CO_2$, and the emission of NO and NOx were less than one thousandth the concentration of $CO_2$. The PAH content of the smoke was enriched in the larger molecular weight species in comparison with the original fuel. A methodology was developed with which the down-wind dispersal of smoke generated by one or more oil-spill fires in close proximity may be predicted.

7347 **(PB—89109052/XAB) Environmental Monitoring Plan for the Forest Hill Heavy Oil Project. Final report.** (Greenwich Oil Corp., Dallas, TX (USA)). 20 Jun 1986. 200p. NTIS, PC A09/MF A01.

The Energy Security Act of 1980 established a program to provide financial assistance to private industry in the construction and operation of commercial-scale synthetic-fuels plants. The Forest Hill Heavy Oil Project is one of the four projects awarded financial assistance. The Project agreed to comply with existing environmental-monitoring regulations and to develop an Environmental Monitoring Plan incorporating supplemental monitoring in the areas of water, air, solid waste, worker health and safety, and socioeconomic impacts during the period 1985-1991. The Forest Hill Heavy Oil Project site outside Quitman, Texas extends three miles over the Harris Sand formation. Air-injection wells for air injection and fireflooding are located throughout the field. The document outlines the requirements and schedules for operating in full compliance with all federal, state, and local regulations and requirements of the Commitment to Guarantee with the U.S. Department of Treasury.

7348 **(TU/CEA—EE-104) A study of oil dispersion: the role of mixing and weathering.** Chau, A.; Mackay, D. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1988. 52p. (MICROLOG—88-05252). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A review is presented of factors influencing the dispersion of crude oils on seawater using chemical dispersants. In this study, various experimental approaches were attempted with a view to elucidating the underlying determinants of dispersant effectiveness. These include: dispersant delivery, oil-dispersant mixing, and oil weathering. The mixing phenomena have been shown to be very complex and are probably impossible to model accurately. The best that can be hoped for is a set of empirical rules or observations which are suported by theoretical principles. Attempts have been made to identify the presence of an oil film which retards mixing,

using interfacial viscosity and ice-contact experiments, but the results are not satisfactory. Dispersion data have been re-interpreted using a triangular diagram approach. This has produced some interesting insights, including the suggestion that dispersion may be limited by the volume of accessible water and a maximum achievable emulsion concentration. A model has been assemble to quantify the role of weathering on dispersant effectiveness and to elucidate the presence of a time window for dispersion. 12 refs., 26 figs., 5 tabs.

7349 **Biodegradation of hydrocarbons in the environment.** Atlas, R.M. (Univ. of Louisville, KY (USA)). pp 211-222 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Studies on the environmental fate of petroleum have demonstrated the nearly ubiquitous distribution of microorganisms that can metabolize hydrocarbons. The rates of degradation depend upon the concentrations of such microbes and upon the environmental characteristics of an oil-contaminated ecosystem. Given the appropriate environmental conditions, microorganisms effectively decontaminate, by their biodegradative metabolism, environments that have received petroleum pollutants. Higher-molecular-weight compounds, especially those with multiple condensed ring structures and with highly branched or substituted compounds, are relatively resistant to microbial attack. Despite the fact that a geneticall-y engineered hydrocarbon degrader was the first organism ever patented and that seed cultures are produced by various commercial firms, enhanced biodegradation as a result of seeding generally has not been shown to be effective. Also, even though some anaerobes have not been demonstrated to be capable of hydrocarbon metabolism, hydrocarbons persist indefinitely in anoxic environments. Environmental modification, on the other hand, such as that achieved by aeration or fertilization with nitrogen and phosphorus, has not been shown to enhance biodegradative removal of hydrocarbons. Having considered the various factors that influence the rates of hydrocarbon degradation, we are left with the question of what to do when environmental oil contamination occurs in order to minimize its persistence and thus its long-term effects. Clearly, treatment methods should enhance rather than inhibit the natural rates of oil biodegradation. In some cases, it is possible to modify environmental parameters to enhance rates of hydrocarbon biodegradation, but such methods are rarely undertaken. The translation of our scientific knowledge of hydrocarbon biodegradation into practical applications remains a major challenge.

## 0210 Legislation And Regulation

*REFER ALSO TO CITATION(S) 7331*

7350 (CERI—1988, pp 10) **US regulatory changes in oil and gas and their impact on Canadian imports.** van Orman, C.L. (US Dept. of Energy, Washington, D.C.). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

An outline is given of energy policy in the USA and its implications for imports of Canadian oil and gas. The policy focuses on supplying a sufficient energy supply at a reasonable cost, and in order to achieve this goal, strategies have been adopted that advocate minimum market intervention and a balanced, mixed energy resource system. Some policies that have a direct bearing on Canada-USA trade are described. Import application guidelines have been revised to bring about a flexible approach to pricing and contracts, pricing through market forces rather than regulation, and simplification of review procedures. Voluntary programs have been established for open access transportation by interstate pipelines at flexible, nondiscriminatory rates. Blanket import/export authorizations are being granted. An act forcing industries and electric utilities to burn coal instead of gas or oil has been repealed. It is concluded that these measures are having a beneficial effect on Canada-USA energy trade. 3 figs.

7351 (CERI—1988, pp 4) **Oil and gas policy and prospects to 2005 - Norway.** Haraldsen, O.S. (Ministry of Petroleum and Energy, Norway). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

This presentation gives a short description of Norway as a net energy producer, and outlines future developments in domestic energy consumption and supplies. A primary objective of Norway's energy policy is to assure energy supplies at the lowest cost possible for the society; the price paid should reflect the cost of providing more energy. The oil and gas sector's role in this policy is discussed. Important social objectives include a petroleum industry formed as a basis for the development of competitive industries. The primary policy objective is to have petroleum resources developed in accordance with economic interests. Stable prices at a reasonably high level are felt to be in the best long-term interest for the country. The presentation concludes with a generalized summary of Norwegian oil and gas reserves and markets.

7352 **(DOE/IE/10481—T1) Methodolgy for determining differential tanker rates for SPR oil movement in an energy emergency: Final report.** (Charles River Associates, Inc., Boston, MA (USA)). Sep 1988. Contract AC01-85IE10481. 60p. (CRA—200.11). NTIS, PC A04/MF A01 - OSTI. Order Number DE89003538/JAW.

Jones Act ships must be used to move crude and petroleum products between US ports. However, if no suitable Jones Act tankers or barges are available, shippers may apply, on a case-by-case basis, for a wavier to use substantially cheaper foreign capacity instead. Case-by-case determination of these waivers creates a potential problem for an emergency drawdown of the Strategic Petroleum Reserve (SPR): potential buyers of crude would have to submit bids while facing considerable uncertainty about their ultimate costs of transporting the SPR oil. This report examines an alternative to the case-by-case waiver process, which we call a "composite waiver procedure." The composite waiver procedure has two elements: a general waiver of the Jones Act requirement for moving SPR crude; and a rebate, equal to the price differential between foreign ships and Jones Act ships, to be paid to any buyer of SPR crude who uses US bottoms for transport. The composite waiver is designed to reduce the uncertainty surrounding transportation costs in the crude bidding process, and to keep Jones Act tankers price competitive so these vessels are not eliminated from use during an SPR emergency drawdown. 17 figs.

## 0220 Transport, Pipelines, And Handling

*REFER ALSO TO CITATION(S) 7352*

7353 **(EPS—WNR-88/89-1) Petroleum product storage and handling at federal facilities in southern Manitoba.** Youmans, T. (Environnement Canada, Ottawa, Ontario. Conservation et Protection). 1988. 37p. (MICROLOG—88-05250). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A survey of petroleum product storage and handling practices was undertaken in 1987 and 1988 at Canadian federal facilities in southern Manitoba. The survey was part of a continuing program to assess compliance with Manitoba Regulation 97/88R, relating to the storage and handling of gasoline and associated products, a copy of which is included in this report. The initial phase of the program involved a survey of the Manitoba Interlake region, completed in early 1987. Inventory data were compiled and compared with the requirements of the regulation. Owners of tank systems that were out of compliance were requested to undertake corrective actions to address the deficiencies ehat were noted. Most tank systems were out of compliance with the regulation, with the frequency of non-compliance typically more than 30%. Concerns were identified with old tank systems located in sensitive areas of the province. The types of deficiencies noted in this survey includ-

ed non existent or incomplete inventory reconciliation records, tanks installed without proper corrosion protection, abanded tanks not rendered unusable, and inadequate diking of above-ground tanks. 1 ref., 3 figs.

## 0230 Properties

7354 **(AD-A—197270/2/XAB) Properties of JP-8 jet fuel. Summary report, August 1984-April 1988.** Martel, C.R. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). May 1988. 19p. (AFWAL-TR—88-2040). NTIS, PC A03/MF A01.

This report provides a summary of 80 JP-8 jet fuels produced over the time period of August 1984 to April 1988. The data were obtained from the test reports provided by the fuel supplier or receiving terminal. Averages, standards deviations, minimum and maximum values of the various data were determined and are reported.

7355 **(AD-A—197531/7/XAB) Synthetic and alternate fuels characterization. Final report, 31 August 1981-31 January 1988.** Griest, W.H.; Guerin, M.R.; Smith, L.H.; Witschi, H.P.; Higgins, C.E. (Oak Ridge National Lab., TN (USA)). 1 Feb 1988. 98p. (ORNL-TM—10706). NTIS, PC A05/MF A01.

Diesel fuels derived from petroleum and synthetic sources were compared chemically and toxicologically to address the issue of whether a changeover of mobility fuels from natural to synthetic sources might be accompanied by greater or different toxicological hazards to military personnel. Diesel fuels derived from petroleum, shale oil, tar sands, and tar sands/petroleum coprocessing were compared for major organic composition, 4-6 ring polycyclic aromatic hydrocarbon dermal tumorigens, major organic compounds in their inhalable volatiles, mouse dermal tumorigenicity and promoting activity. The data base was expanded by a similar comparison of petroleum- and coal-derived fuels for the U.S. Department of Energy (USDOE). The results suggest that highly refined and finished mobility fuels from synthetic or alternate sources will not pose a significantly greater toxicological hazard than current petroleum-based fuels. Toxicological differences are likely to be subtle.

7356 **(FRNC-TH—3263) New equation of state for the calculation of thermodynamic properties of mixtures Case of petroleum fluids with particular attention to the critical domain.** Simonet, R. (Aix-Marseille-2 Univ., 13 - Marseille (France)). Sep 1978. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756115/JAW.

A new equation of state is developed. Its formulation by a law of corresponding states allows the simultaneous restitution of volumetric properties and liquid-vapor equilibrium along the vapor pressure curve for n-paraffins from methane to hexadecane with an accuracy of 1.66% in the domain 0-1000 atm and 0.5 $\leqq$ T/T/sub c/ $\leqq$ 2 except at the critical point. Other important compounds, in the petroleum domain are represented by this law with the same accuracy: benzene, water, hydrogen, ethylene, hydrogen sulfide and carbon dioxide. Correct values of enthalpy are also given for these compounds either in the liquid or gas phase. Extension of the equation of state to mixtures gives thermodynamic data, in particular specific weight and equilibrium coefficient with enough accuracy for production and deposit studies. An important application is volume evaluation of gas condensates in a gas deposit by decompression.

## 0240 Storage

7357 **(AD-A—197169/6/XAB) Gum and deposit formation in diesel fuels. Final report, 1984-1988.** Mayo, F.R.; Mill, T. (SRI International, Menlo Park, CA (USA)). 15 May 1988. 101p. (SRI-PYU—7753). NTIS, PC A06/MF A01.

The authors examined two aspects of the stability of diesel fuels in storage: the formation of sediments in suspension, which subsequently clog filters, and the formation of soluble gum, which passes the filters but then forms hard deposits on hot engine parts. Research on fuel stability at SRI during the last 6 years has shown that soluble gum appears first on storage, and then part of it grows into sediment. If the oxidation mixture is agitated gently, the precipitating gum grows on the surface gum, and no loose sediment is formed. Three mechanisms of gum formation were distinguished: (1) a process intimately associated with chain propagation and termination during oxidation, (2) a coupling of fuel molecules by decomposing peroxides in the absence of oxygen, and (3) a condensation of naphthols and aldehydes from the oxidation of alkylnaphthalenes. The polymeric oxidation products from a JP-8 fuel are shown to be largely responsible for deposits in the Jet Fuel Thermal Oxidation Tester (JFTOT).

7358 **(PB—89-113757/XAB) Design of the underground storage tank (UST) release simulation model. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Apr 1988. 22p. (SAB/EEC—88/029). NTIS, PC A03/MF A01.

The Committee concluded that the overall structure and design of the Underground Storage Tank (UST) Release Simulation Model developed by the Office of Underground Storage Tanks for the purpose of developing a Regulatory Impact Analysis of the requirements proposed to regulate underground gasoline-storage tanks is sound, but only in the context of substantiating regulatory decisions on underground gasoline tanks that have been made by other means. The Committee recommends that the model results should be compared to simpler order-of-magnitude estimates of tank failures and impacts based on a first-order characterization of tank ages and failure probabilities. The simplified and full models should each be compared to data bases on tank failure that are currently becoming available. The committee recommended that the model code should be documented to facilitate wider use.

## 0250 Combustion

*REFER ALSO TO CITATION(S) 7281*

7359 **(DOE/BC/14126—4) The effect of metallic additives on the kinetics of oil oxidation reactions in in-situ combustion.** De los Rios, C.F.; Brigham, W.E.; Castanier, L.M. (Stanford Univ., CA (USA). Petroleum Research Inst.). Nov 1988. Contract FG19-87BC14126. 98p. (SUPRI-TR—63). NTIS, PC A05/MF A01 - OSTI. Order Number DE88001248/JAW.

In-situ combustion is a process whose applicability is partly determined by the combustion characteristics of the specific crude oil in question. These characteristics are directly influenced by the rate of oxidation reactions occurring in the rock matrix ahead of the combustion front. A method is therefore sought by which these characteristics may be altered within a reservoir, thus making the process feasible for a wider variety of crude oils. The presence of catalysts may have a significant influence on the reactions. The effects of catalyzing agents on the kinetics of these reactions were therefore studied to gain a more thorough understanding of the mechanisms involved in the catalysis of crude oil oxidation. Experiments were conducted wherein samples of a Huntington Beach oil/sand mixture were subjected to a continuous flow of air and a linear heating schedule. The effects of differing operating pressure and ten different metallic additives were examined in an experimental program of sixteen runs. 20 refs., 55 figs., 8 tabs.

7360 **(QU/CE—1987) Pilot scale trials on atmospheric fluidized bed combustion of a Saskatchwan petroleum coke.** Becker, H.A.; Code, R.K.; Stephenson, J.R. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Chemical Engineering). [1987]. 64p. (MICROLOG—88-03136). Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Trials on the burning of petroleum coke, a residue of the processing of Alberta light crude oil, were performed in an atmospheric fluidized bed combustion (AFBC) pilot plant. Sand was usually used as the bed material but several trials with limestone were also performed. Other conditions of the trials were mean coke par-

ticle diameter 0.28 mm; fluidizing velocity, 1.1--1.9 m/s; excess air, up to 15%; cyclone recycle ratio (fraction of cyclone catch recycled), 0--1; and bed temperature, 833-1005/sup 0/C. The combustion efficiency as measured by carbon burnup was 65-99%. Correlation of combustion efficiency with the operating variables demonstrates close similarity with the burning of Syncrude coke. Although sand beds were used in most of the work, substantial sulfur capture was nevertheless generally observed. The data show that this is due to sulfur retention and concentration in the unburnt char. The S/C mole ratio of the char can be as high as three times that of the fuel. Nitric oxide emissions were ordinary for AFBC, showing 8-29% conversion of fuel nitrogen to NO. The work covered an unusually extended range of the cyclone recycle ratio, right up to a total recycle of the cyclone catch. In correlating combustion efficiency, it was found that the cyclone recycle ratio inadequately characterizes the effects of recycle when it is $> 0.90$. The overhead recycle ratio, the fraction of cyclone catch plus baghouse catch that is recycled, serves much better and indeed appears to be wholly adequate. 7 refs., 30 figs., 8 tabs.

# 03 NATURAL GAS

*REFER ALSO TO CITATION(S) 8003*

## 0301 Reserves

*REFER ALSO TO CITATION(S) 7374*

## 0302 Geology And Exploration

*REFER ALSO TO CITATION(S) 7292, 7295, 7296, 7297, 7298*

7361 **(ACOH/SD—87) Well testing. Minimum guidelines for safety enhanced field operations.** (Alberta Community and Occupational Health, Edmonton (Canada). Occupational Health and Safety Div.). [1987]. 28p. (MICROLOG—88-05115). Alberta Legislative Library, 216 Legislature Bldg., Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document is intended to alert well testing personnel and the oil and gas industry in Alberta to the minimum safety requirements and to clarify conditions and operations peculiar to well testing. General safety standards and personel requirements and qualifications are outlined. Specifications are given for pressure vessels, pressure piping, flanges and other connections, flexible piping, materials for hydrogen sulfide service, pipe threading, and welding. Recommendations are made for layout of wells and equipment, and startup and operating procedures for: sweet wells with cold separator, sweet and caution wells with a heated test unit, sour wells, and critical sour wells. 3 figs., 1 tab.

7362 **(PB—89-100739/XAB) Northern Gulf of Mexico continental slope study. Annual report (Year 3), Volume 1. Executive Summary.** Gallaway, B.J.; Martin, L.R.; Howard, R.L. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Feb 1988. 156p. NTIS, PC A08/MF A01.

See also Volume 2, PB—89-100747; Also available in set of 3 reports PC E99, PB—89-100721.

In 1983, the Minerals Management Service initiated a multiyear program to study the continental slope of the northern Gulf of Mexico as part of its outer continental shelf environmental studies program. The particular program, the Northern Gulf of Mexico Continental Slope Program, has three primary goals: (1) to determine the abundance, structure, and distribution of animal communities in the deep sea Gulf of Mexico; (2) to determine the hydrography and bottom conditions at selected sites within the study area and to relate these to faunal variations; and (3) to measure present levels of hydrocarbon contamination in deep sea sediments and selected animals. Volume I is the Executive Summary.

7363 **(PB—89-114805/XAB) Well sample/borehole diagnostic methods for tight black shales. Final report, October 1985-August 1988.** Curtis, J.B. (Exlog/Brown and Ruth Labs., Inc., Englewood, CO (USA)). May 1988. 194p. NTIS, PC A09/MF A01.

See also PB—88-166889.

This study was designed to aid industry in the exploitation of the shale gas resource, and consisted of two complementary parts. (1) A well-site technique was developed to evaluate the production potential of the Devonian shale and other low-permeability formations. The instruments measure the concentration and composition of free hydrocarbons and the source potential of cuttings/core samples. Examples of the use of the technology to determine the presence of free gas or oil, identify hydrocarbon reservoirs, and locate potentially permeable zones are presented in the report. The well-site geochemistry technique complements the GRI well log interpretation work as a formation evaluation tool for the Devonian shales. (2) A regional geochemical framework of the shale formations was completed. The framework incorporates the data from the 15 GRI study wells analyzed by wellsite geochemistry as well as data from an additional 48 preexisting wells. The geochemical framework facilitates understanding of the occurrence of hydrocarbons in the Devonian shale sequence and calculation of the amounts of hydrocarbons generated within key shale formations.

7364 **In-situ measurement of weak transverse isotropy within the Mesa Verde formation.** Phillips, W.S.; Johnson, P.A. (Los Alamos National Lab. (US)). pp 290-292 of Proceedings of the 57th annual international SEG meeting: Expanded abstracts with biographies. Tulsa, OK; Society of Exploration Geophysicists (SEG) (1987). (CONF-871012—).

From 57. annual international meeting and exposition of the Society of Exploration Geophysicists; New Orleans, LA, USA (11 Oct 1987).

Technical Paper POS 2.2.

The authors employed the crosswell seismic method to study the anisotropic nature of a mineralogically homogeneous Mesa Verde sandstone at depths of nearly 2000 m near Rifle, Colorado. Elastic moduli determined from P and SV travel-times indicate that a transversely isotropic model is more consistent with the data than is a purely isotropic model. Comparison of the authors' results with a large compilation of transverse isotropic moduli measurements, mostly from lab samples, shows remarkable agreement in spite of large differences in experimental scale.

## 0303 Drilling, Production, And Processing

*REFER ALSO TO CITATION(S) 7374, 7381*

## 0304 Products And By-products

*REFER ALSO TO CITATION(S) 7374*

7365 **(PB—89-112312/XAB) Helium resources of the United States, 1987. Information Circular/1988.** Miller, R.D. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1987. 24p. (BM-IC—9189). NTIS, PC A03/MF A01.

See also PB—87-214664. Library of Congress catalog card no. 88-600363.

The helium-resources base of the United States was estimated by the Bureau of Mines to be 1040 Bcf as of January 1, 1987. These resources are divided into four categories in decreasing degree of assurance of their existence: (1) helium in storage and in proved natural gas reserves, 265 Bcf, (2) helium in probable natural gas resources, 228 Bcf, (3) helium in possible natural gas resources, 320 Bcf, and (4) helium in speculative natural gas resources, 227 Bcf. These helium resources are further divided into depleting and nondepleting, with the helium in storage being in a separate classification.

7366 **(PB—89-113948/XAB) Hazardous organic wastes from natural-gas products processing and distribution: environmental fates. Technical report.** Eiceman, G.A. (New Mexico State Univ., Las Cruces (USA). New Mexico Water Resources Research Inst.). Nov 1986. 98p. (WRRI—227). NTIS, PC A05/MF A01.

Hydrocarbons and polycyclic aromatic hydrocarbons are generated as waste fluids and solids in natural gas production, processing, and distribution. Wastes are disposed in earthen unlined waste pits, sometimes near vulnerable aquifers. As expected, groundwater contamination does occur in river flood plains where depth to groundwater can be less than 2 meters. Contamination of ground water and nearby soils with hydrocarbons from an unlined pit was documented in the Duncan Oil Field west of Farmington, NM. Plumes for volatile compounds including benzene, toluene, and xylenes in the water and polycyclic aromatic hydrocarbons in the soil were evident downgradient from the earthen pit at distances up to 50 meters. Waste pits containing produced water and hydrostatic discharge water were found to contain large amounts of polycyclic aromatic hydrocarbons which are phototoxic to fish.

## 0306 Marketing And Economics

*REFER ALSO TO CITATION(S) 7329, 7374, 7541, 7948, 8036*

7367 (CERI—1988, pp 12) **Alberta natural gas marketing challenge.** Graburn, W.L. (Canadian Western Natural Gas Co. Ltd.). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

This presentation addresses some of the questions involved in marketing natural gas in Alberta. Deregulation of the market and its impact on an Alberta gas supplier is discussed. The provincial gas market is established and secure, and has shown a rapid increase due to the development of petrochemical and fertilizer industries; sales of gas outside Alberta are also large, but future developments in this market are being affected by requirements for security of supply and by the current gas surplus.

7368 (CERI—1988, pp 10) **The southern California gas market.** Loch, R.M. (Pacific Interstate Transmission Co., Los Angeles, CA). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

This report presents, in outline form, an introduction to the natural gas market in southern California from the point of view of the largest gas distributor in that area. Sources of supply are identified and Canadian sources and purchases are empahsized. Recent regulatory changes have significantly affected the role of the local distributor, notably in the area of increased market openness. Also, state regulations dividing the market into core and non-core segments, whose market requirements are outlined, have brought about a market now consisting of utility sales and direct sales markets. The potential for additional Canadian gas sales in the area is limited, at least in the short term, by the availability of pipeline capacity. However, Canadian gas producers can still compete in this market if their prices remain competitive. 10 figs.

7369 (CERI—1988, pp 2) **Gas marketing challenges in the US: a developed urban market.** Terry, R.E. (Peoples Gas, Light and Coke Co., Chicago, IL). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

The natural gas market in the Chicago area is described, and characterized as mature and stable, with limited growth potential. The criteria that suppliers to this market will have to meet are discussed: high reliability, flexibility in required takes, and low price. It is noted that the local distribution companies do not earn any profit on their gas cost, thus it is the responsibility of the seller to bear the risk associated with the wellhead price of the gas.

7370 (CERI—1988, pp 2) **Developments in the northeast American gas market.** Catell, R. (Brooklyn Union Gas Co., NY). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

Highlights are given of the market, regulatory and sourcing developments for natural gas in the northeast USA. Several characteristics of that market, as well as current trends in regulatory proceedings, should serve to increase the amount of gas which both Canadian and US producers dedicate to the northeast.

7371 **(PB—89-100671/XAB) Mineral-wool industry: opportunities for natural gas technologies. Topical report, January-July 1987.** (Charles River Associates, Inc., Boston, MA (USA)). May 1988. 53p. (CRA—208.01). NTIS, PC A04/MF A01.

To quantify the opportunities for natural gas and identify technological advances needed to capture such opportunities, the mineral-wool industry was analyzed with respect to the principal companies, their capabilities, and markets. The mineral-wool industry is stable with a slightly declining market. Of its market segments, only commercial acoustic insulation (which is currently dominant) is likely to be affected by growth in the next ten years. The principal process is based on treatment of blast-furnace slags in a cupola furnace using coke as the fuel and reducing agent. Expanded use of gas, as a substitute for coke, would eliminate environmental problems and expand the latitude of suitable raw materials. The study provides insights into the mineral-wool industry and identifies factors that may constitute bases for future usage of natural gas.

## 0307 Waste Management

*REFER ALSO TO CITATION(S) 7366*

## 0309 Artificial Stimulation

7372 **(DOE/METC—88/4084) Well test analysis of the Travis Peak C-1 sandstone in the Howell No. 5 well, Waskom Field, Harrison County, Texas: Technical note.** Duda, J.R.; Ammer, J.R.; Brummert, A.C. (USDOE Morgantown Energy Technology Center, WV). Sep 1988. 80p. NTIS, PC A05/MF A01 - OSTI. Order Number DE88010278/JAW.

Four pressure drawdown/buildup tests were analyzed and interpreted to characterize the Travis Peak C-1 sand in the east Texas No. 5 Howell well, a special field test conducted for the Gas Research Institute. The four tests were performed before a minifracture, after the minifracture, and after the main fracture (two tests). The test data set was made available to several research organizations including the Morgantown Energy Technology Center. The results of these tests were studied by two groups at the Morgantown Energy Technology Center that used two different methods to provide a thorough and comparative analysis of the data. The body of this report summarizes the results of both analyses. The appendices contain detailed calculations that support the results of the two analyses. The pre-fracture buildup test was executed and the data were analyzed in order to establish base line reservoir properties, such as reservoir permeability. The pressure transient tests that were conducted after the main stimulation were analyzed to (1) describe the induced hydraulic fracture through derivation of fracture conductivity and effective fracture half-length, and (2) assess the induced fracture's efficiency with respect to the type and volume of fracture fluid and the resulting gas deliverability of the zone. These objectives were met despite data anomalies, which were characterized by abnormal increases of pressure at later times that generally corresponded to the beginning of the infinite-acting, radial flow period. The primary analysis method for determining

formation permeability was type-curve matching of pressure-time data. 10 refs., 10 figs., 5 tabs.

7373 **(PB—89-125298/XAB) Enhanced gas production through hydraulic fracturing of coal seams. Annual report, January-December 1987.** Holditch, S.A.; Carter, R.H.; Ely, J.W.; Semmelbeck, M.E.; Hinkel, J. (Holditch (S.A.) and Associates, Inc., College Station, TX (USA)). Jan 1988. 139p. NTIS, PC A07/MF A01.

During the past few years, research projects conducted by the Gas Research Institute have clearly shown that methane from coal seams is a gas source which has the potential for providing large volumes of natural gas. The report presents the initial results of a study to determine the optimal completion strategies, fracture-fluid systems, fracture-propagation modeling, and hydraulic-fracturing techniques needed to stimulate coal seams. Results from numerical modeling and coal fines generation laboratory studies are presented. During 1988, refinement of theoretical concepts and coal-seam fracturing strategies will be pursued by implementing a series of field cooperative experiments. The end result of this work will be the publication of a fracture-design manual specifically for coal-seams stimulation. The manual will aid the industry in maximizing gas production from coal seam reservoirs by providing guidelines for successful completions and hydraulic-fracture-treatment designs.

## 0310 Legislation And Regulation

*REFER ALSO TO CITATION(S) 7350*

## 0320 Transport, Pipelines, And Handling

7374 **(DOE/EIA—0167(87)) Gas supplies of interstate natural gas pipeline companies, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 8 Dec 1988. 117p. NTIS, PC A06/MF A01 - GPO - OSTI. Order Number DE89004401/JAW.

Gas Supplies of Interstate Natural Gas Pipeline Companies 1987 was prepared by the Reserves and Natural Gas Division, Office of Oil and Gas, Energy Information Administration (EIA). The publication provides information on the total reserves, production, and deliverability capabilities of the 87 interstate pipeline companies required to file the Federal Energy Regulatory Commission (FERC) Form 15, "Interstate Pipeline's Annual Report of Gas Supply." This publication is the 25th in a series of annual reports on the total gas supplies of interstate pipeline companies since the inception of individual company reports to the Federal Power Commission (FPC) in 1964 for report year 1963. This publication provides information on the interstate pipeline companies' supply of natural gas during calendar year 1987, for use by the FERC for regulatory purposes. It also provides information to other government agencies, the natural gas industry, as well as policy makers, analysts, and consumers interested in current levels of interstate supplies of natural gas and trends over recent years. 6 figs., 18 tabs.

7375 **(EUR—11130) Report on a BCR audit of measurements of static differential pressures at high line pressures.** Daborn, J.E. (National Physical Lab., Teddington (UK)). (Commission of the European Communities, Luxembourg). 1987. 101p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756032/JAW.

This report gives the results of an international intercomparison of standards for the measurement of static differential pressures at high line pressures, organized under the auspices of the European Community's Bureau of Reference (BCR). Such measurements are of particular importance in the metering of natural gas in pipelines. Silicon diaphragm pressure transducers were used as the transfer standards and measurements were carried out for differential pressures in the range 0 to 150 kPa at line pressures of 4 and 8 MPa. The repeatability of the transfer standards was estimated to be better than +0.05%. At 4 MPa line pressure the difference between participants was within 0.25% at 30 kPa differential pressure and was within 0.13% in the differential pressure range 60 to 150 kPa. At 8 MPa the greatest difference was within 0.41% at 30 kPa and was within 0.23% in the range 60 to 150 kPa.

7376 **(NP—9770166) Natural gas distribution systems: Reduced models and optimized operation.** Stelter, R. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 13 - Elektrotechnik). 1 Jul 1987. 159p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770166/JAW.

The study deals with the systematic two-step reduction of models for natural gas distribution systems. Combined with an innovative operational optimization method the rapid digital simulation model presented allows to determine optimum initial values for gas compressor stations of larger-scale natural gas distribution systems.

7377 **(PB—89-115299/XAB) Theory for accelerated slow crack propagation in polyethylene fuel pipes. Annual report, 1987-1988.** Moet, A.; Chudnovsky, A.; Chaoui, K.; Strebel, J. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Macromolecular Science). Jun 1988. 47p. NTIS, PC A03/MF A01.

See also PB—88-141577.

The report describes a test for assessing the resistance of polyethylene fuel gas pipe materials to brittle crack propagation. The test employs fatigue loading to a notched specimen. Pipe specimens prepared from 2306-IIC and 2306-IA exhibit an initial stage of brittle crack propagation which becomes progressively ductile as it approaches ultimate failure by tearing. The complete test duration is extremely short in comparison to others currently employed, yet it similarly ranks both materials tested. Further, crack layer analysis is employed to evaluate the specific energy of fracture, gamma, a fundamental parameter characteristic of the material's resistance to brittle-crack propagation. It is also found from microscopic examinations that brittle fatigue involves a crazing mechanism known to occur under creep condition.

7378 **(PB—89-850424/XAB) Natural gas transport by plastic pipes. January 1970-October 1988 (Citations from the Compendex data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 42p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the use of plastic piping to transport natural gas or liquid propane gas. The interaction between gas odorants and plastic pipe, the effects of aging on plastic pipe used to transport gas, and pipe-failure analyses are examined. Bending, joining, and repair methods are discussed. Composite-reinforced plastic pipes and plastic coated pipes are considered. Polyethylene and epoxy composites are among the materials discussed. Gas-main upgrading projects that replaced old pipes with plastic ones are briefly cited. (Contains 77 citations fully indexed and including a title list.)

7379 **(PB—89-851554/XAB) Natural gas: marine transportation. January 1974-November 1988 (Citations from Oceanic Abstracts). Report for January 1974-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 147p. NTIS PC N01/MF N01.

Supersedes PB—85-861656.

This bibliography contains citations concerning the design, construction, and operation of ships for the transport of liquified natural gas. Topics include safety devices, materials handling equipment for loading and unloading liquified natural gas, new hull and vessel designs, gas-turbine propulsion systems, cargo tank designs and requirements, and liguid load dynamics. (This updated bibliography contains 349 citations, 50 of which are new entries to the previous edition.)

## 0330 Properties

*REFER ALSO TO CITATION(S) 7356, 7363*

7380 **(PB—89-112304/XAB) Analyses of natural gases, 1987. Information Circular/1988.** Moore, B.J.; Sigler, S. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1987. 80p. (BM-IC—9188). NTIS, PC A05/MF A01.

See also PB—88-232228. Library of Congress catalog card no. 88-600364.

This report contains analyses and related source data for 191 natural gas samples from 22 states and 1 foreign country. Of the total samples, 182 were collected during calendar year 1987. The remainder were collected earlier, but releases granting permission to publish were not received before 1987. All samples were obtained and analyzed as part of Bureau of Mines investigations of the occurrences of helium in natural gases of countries with free-market economies. The survey has been conducted since 1917. The analyses were made by mass spectrometry and gas chromatography.

7381 **Pressure-core measurements in tight sandstone lenses during the multiwell experiment.** Sattler, A.R.; Heckes, A.A.; Clark, J.A. (Sandia National Labs. (US)). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 3: No. 3, 645-650(Sep 1988).

A pressure-coring operation was performed in two tight sandstone lenses of the Mesaverde group during the drilling of one well of DOE's Multiwell Experiment (MWX). The goals were (1) to obtain accurate water saturation data; (2) to measure the amount and composition of gas on a foot-by-foot basis; and (3) to recover fluids for water-chemistry analysis. This application of pressure coring had not been tried before; it was felt to be a novel approach for accurate water-saturation measurements in tight sandstone core. Several changes to usual pressure-coring procedures were adopted, including the development of an organic, noninvasive coring fluid compatible with the oil-based drilling fluid used to help preserve the original water saturation. The pressure-core assembly was modified so that gas samples could be taken directly from the inner barrel and would allow the capture of any gas not trapped during the process; however, none was found. Water-saturation data were obtained on the pressure core by both Dean-Stark distillation and vacuum-oven drying. The analyses of all recovered core suggest that water-extraction procedures should be carried on for a long time and that the Dean-Stark procedure may not be the water-extraction procedure of choice for tight sandstone core. These analyses showed no appreciable water-saturation difference on rock with the same porosities. No fluid was recovered during thawing alone; the rock was too tight. Gas was obtained in the pressure-coring process and measured on a foot-by-foot basis.

### 0340 Combustion

*REFER ALSO TO CITATION(S) 8006, 8052, 8099, 8709, 8777*

7382 **(PB—89-103915/XAB) NOx chemistry in natural gas flames. Annual report, May 1987-May 1988.** Zabielski, M.F.; Woody, B.A. (United Technologies Research Center, East Hartford, CT (USA)). 31 May 1988. 54p. (R—957376-2). NTIS, PC A04/MF A01.

See also PB—87-232179.

An improved frequency-modulated laser facility is described along with the results of a study of the spectroscopy of $NO_2$. Low-pressure (35-45 torr) methane and hydrogen flames, whose stoichiometries were varied from lean to rich, were studied with laser frequency-modulated absorption spectrometry and molecular-beam-sampling mass spectrometry. These flames were also seeded with $NO_2$ and NO at concentration levels from 0.6-2.1%. The decay of $NO_2$ was measured in both types of flame. The rate of production of $NO_2$ from seeded NO (1.2%) in the cool regions of these flames was also studied. In both flames, no significant $NO_2$ (<5 ppm) was detected. A model of the hydrogen flame predicted peak $NO_2$ concentrations in excess of 500 ppm. The discrepancy is being investigated. CH measurements were made in an oxygen-enriched methane/air flame with FM spectroscopy. The signal-to-noise ratio of these data is excellent. As part of the calibration process for the FM technique, a series of measurements on C2H2/O2 flames were made with direct optical absorption and mass spectrometry.

## 04 OIL SHALES AND TAR SANDS

### 0402 Site Geology And Hydrology

7383 **(PRI—1981-5) A geological study of three Manville Sand Reservoirs - Chauvin South (Sparky A and B), Provost (Upper Manville B), and BODO David (Lloydminster A).** Gross, A.A. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1981. 103p. (CE—02105). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Three Mannville sand reservoirs of east central Alberta were selected when examining the application of specific enhanced oil recovery processes: Chauvin South - Sparky A & B (polymer application), Provost - Upper Mannville B (steam stimulation), and David - Lloydminster A (polymer flooding). In each case, the project started with a geological study of the reservoir. In this report, the results of the geological studies of the three pools are presented. Emphasis has been placed on reservoir petrology and reservoir geometry, with information derived from core studies and scanning electron microscopy. Stratigraphically, the three reservoir sands examined all belong to the Lower Cretaceous Mannville Group, and the pools are in close geographical proximity. However, these sands were deposited under different conditions, and little similarity can be anticipated between them in terms of reservoir behavior. The geometry of a pool is based on a partly hypothetical interpretation of the geology using scattered well data. For a mathematician who is building a numerical model of the pool, an understanding of both physical concepts and interpretive uncertainties facilitates realistic adjustments of uncertain parmeters during the course of history matching. A comparison of the pools studied is made to emphasize some of the differences in types of interwell communication that can be anticipated. 14 refs., 76 figs.

7384 **Nineteenth oil shale symposium proceedings.** Gary, J.H. Golden, CO; Colorado School of Mines Press (1986). 250p. (CONF-8604172—). Colorado School of Mines Press, Publications Center, Golden, CO 80401.

From 19. annual oil shale symposium; Golden, CO, USA (21 Apr 1986).

This book contains 23 selections. Some of the titles are: Effects of maturation on hydrocarbon recoveries from Canadian oil shale deposits; Dust and pressure generated during commercial oil shale mine blasting: Part II; The petrosix project in Brazil - An update; Pathway of some trace elements during fluidized-bed combustion of Israeli Oil Shale; and Decommissioning of the U.S. Department of Energy Anvil Points Oil Shale Research Facility.

### 0403 Drilling, Fracturing, And Mining

*REFER ALSO TO CITATION(S) 7384*

7385 **(CANMET—CRL87-122) Western Canadian surface mining technology.** Singhal, R.K.; Stewart, D.B.; Golosinski, T.S.; White, P. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1987. 38p. (MICROLOG—88-01555). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Western Canadian surface mines are highly mechanized. This paper reviews the current state of mechanization in that surface mining industry and highlights the innnovative practices adapted and developed by surface mine operators. As oil sands development is an area where Canada is in the forefront of mining and processing technology, emphasis has been placed in discussing the surface mining technology of oil sand operations. Coal mining also receives significant mention. Significant developments include bucket wheel excavators, high angle conveyors, modifications of equipment to take into account the characteristics of Canadian bitumens, hydraulic shovels and selective miners, and feeder breakers. Applications of microprocessor technology to mine management,

equipment control systems, monitoring, automation, and remote control are also discussed. 22 figs., 2 tabs.

## 0404 Oil Production, Recovery, And Refining

*REFER ALSO TO CITATION(S) 7195, 7384*

7386 **(ARC/OS—1988) Oil Sands and hydrocarbon recovery research at the Alberta Research Council.** dePlessis, M.P. (Alberta Research Council, Edmonton (Canada). Oil Sands Research Dept.). [1988]. 23p. (CE—02023). Alberta Research Council, Editing and Publications Sales Dept., 5th. Floor, Terrace Plaza, 4445 Calgary Trail South, Edmonton, Alta., Canada T6H 5R7; $N/C.

The mission of the Alberta Research Council is to aid the economic development of the province. Exploitation of Alberta's vast hydrocarbon resources is central to this mission. A patent issued to Dr. Karl Clark of the Research Council in 1928 formed the basis for the hot water extraction processes used in present commercial operations for mined oil sands. In 1971 the research focus shifted to in-situ recovery of oil from the more plentiful and deeper deposits and on ways to make these techniques more economical and more productive. A comprehensive multidisciplinary research program with the associated facilities and infrastructure has been developed. Investigations are conducted on basic mechanisms at work in oil sands, physical properties, geochemistry and geology, modelling, production, and technical/economic evaluation. The program augments and complements related work and expertise in universities and industry, and consequently effectively aids transfer of research concepts to field applications. Where required, projects can draw on the Research Council's capabilities in technical and economic evaluations, expert systems, artificial intelligence, advanced materials and biotechnology to meet the needs of particular industrial applications. 39 refs., 32 figs.

7387 **(ARC/OS—1988/1) Following the vision. Celebrating 60 years of successful oil sands research.** (Alberta Research Council, Edmonton (Canada). Oil Sands Research Dept.). [1988]. 12p. (CE—02025). Alberta Research Council, Editing and Publications Sales Dept., 5th. Floor, Terrace Plaza, 4445 Calgary Trail South, Edmonton, Alta., Canada T6H 5R7; $N/C.

An historical summary is given of scientific research into oil sands and hydrocarbon recovery in Alberta, from the time of the Clark process of hot-water extraction in 1928 to the present activities of the Alberta Research Council. An outline follows of joint Council/industry research projects: improving the economics of enhanced oil recovery, thermal processes for recovery of heavy oil, in-situ recovery of bitumen, preparatory studies for the OSLO development in the Athabasca oil sands, and new oilwell pump technology for heavy oil deposits. A numerical list of patents is also included. 22 figs.

7388 **Pyrolysis of sunnyside (Utah) tar sand: Characterization of volatile compound evolution.** Reynolds, J.G.; Crawford, R.W. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 2, 297-306(Jun 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

Tar sand is defined as any sand or rock which is impregnated with heavy oil or bitumen. (This excludes coal, oil shale, and Gilsonite). In the United States alone, there are an estimated 60 billion barrels of bitumen in tar sand, some of which is recoverable. The Sunnyside deposit in Utah accounts for approximately 4.4 billion barrels of recoverable bitumen, making it an attractive deposit for recovery processing. Several commercial concerns have had financial interest in the development of recovery processing, including in-situ thermal (Shell Oil), steam flooding (Signal Oil and Gas), and solvent extraction (AMOCO). Laboratory pyrolysis of a given tar sand is useful in pyrolysis type recovery research, both in-situ and surface. Several laboratory studies have been performed on Sunnyside tar sand, to elucidate its performance - fluidized-bed and fixed-bed pyrolysis, hydropryolysis, hot water and solvent extraction. This paper summarizes the authors' initial efforts in the laboratory pyrolysis of Sunnyside tar sand, and compares the results to the pyrolysis of other domestic tar sands (Asphalt Ridge from Utah and Big Clifty from Kentucky) studied under the same conditions.

## 0405 Properties And Composition

*REFER ALSO TO CITATION(S) 7238, 7355*

7389 **(AD-A—197683/6/XAB) Environmental fate and effects of shale-derived jet fuel. Final report, October 1984-March 1986.** Pritchard, P.H.; Maziarz, T.P.; Mueller, L.H.; Bourquin, A.W. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). Jun 1988. 99p. (MIPR-N—85-16). NTIS, PC A05/MF A01.

Tests were conducted to compare the environmental fate of shale oil-derived jet fuel with that of petroleum-derived jet fuel. These tests included chemical characterization of the fuels, and the water-soluble fraction of each fuel, also measurement of volatilization and biodegradation rates in laboratory systems designed to simulate three disparate aquatic environments. No major differences in the volatilization and biodegradation rates of the two fuels were found. Differences in composition were generally small and should not cause the behavior of the fuels in aquatic environments to differ.

7390 **(UCID—16986-88-3) Lawrence Livermore National Laboratory oil shale quarterly report, July--September 1988.** Cena, R.J. (ed.). (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 12p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003729/JAW.

The products collected from oil shale retorts are a mixture of primary pyrolysis products and secondary products. Primary products are the individual gases and liquids given off directly by the shale. The solid material remaining can also be mostly a primary product. Primary pyrolysis products will dominate from the pyrolysis of small shale particles in a vacuum. Secondary products are formed from primary products. They may be condensations of the same molecules, reactions between different molecules, or reactions with other materials in the retort. Secondary products are formed after primary pyrolysis during transport, cooling, condensation and collection of retort products. To some extent we have control over the extent of secondary reactions. By understanding them, we may be able to control secondary reactions to improve pyrolysis products and minimize undesirable emissions. In some cases the production of secondary products is a result of reactions that proceed at chemical equilibrium and the ratio of reactants can be predicted. In our current work, certain gas-phase equilibra have been a primary focus. These include the water-gas shift reaction, the sulfur analogue of the water-gas shift, and the COS hydrolysis equilibrium. Very accurate concentration data from pyrolysis carried out both with inert gas sweep and with reactive gas sweep are taken by TQMS and compared to calculated equilibrium concentration ratios. 8 refs., 9 figs.

7391 **Characterization of Nickel and Vanadium compounds in tar sand bitumen by petroporphyrin quantitation and size exclusion chromatography coupled with element specific detection.** Reynolds, J.G.; Jones, E.L.; Bennett, J.A.; Biggs, W.R. (Lawrence Livermore National Lab., Livermore, CA (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 2, 239-246(Jun 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

Tar sands represent a tremendous untapped resource for transportation fuels. In the United States alone, over 60 billion barrels of bitumen are estimated to be in place. In order to use this bitumen, it must be somehow separated from the sand. The resulting bitumen is of low quality, and generally will require at least some refining. Typical refinery upgrading methods include fluid catalytic cracking, thermal visbreaking, and residuum hydroconversion. Most of these methods utilize metals-sensitive catalyst. The metals bound in the bitumen are deleterious to catalytic processing, causing rapid deactivation through poisoning and pore mouth plug-

ging. Like heavy crude oil residua, tar sand bitumens have high concentrations of Ni and V. The types of complexes of Ni and V have been studied for heavy crude oils, and can be placed in two broad categories: the metallopetroporphyrins and the metallononporphyrins. The metallopetroporphyrins have been studied extensively. For understanding the behavior of the metals in processing, size exclusion chromatography coupled with element specific detection by inductively coupled plasma atomic emission spectroscopy (SEC-HPLC-ICP) has been applied to several heavy crude oils, residua, and processed products along with separated fractions of feeds and products. These results have shown general important size-behavior features of the metallopetroporphyrins and metallononporphyrins associated with individual feed characteristics. Because of the importance of the metals in a downstream process methods, the authors have applied several of the metallopetroporphyrin and metallo-nonporphyrin examination technique to extracted bitumen from selected tar sands.

7392 **Comparisons of hydrocarbon and nitrogen distributions in geologically diverse tar sand bitumen.** Holmes, S.A. (Western Research Institute, P.O. Box 3395, Laramie, WY (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 2, 247-252(Jun 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

The characteristics of bitumens from different tar sand deposits are generally significantly different and affect the utilization of the resource. The chemical and physical properties of bitumen are a result of maturation reactions on the varied organic sediments. For example, saturated hydrocarbon distributions have been related to the geochemical history of organic matter. Very paraffinic or sometimes paraffinic-naphthenic distributions in organic matter are derived from a nonmarine depositional environment. More aromatic and paraffinic-naphthenic hydrocarbon distributions are derived from organic matter deposited in a marine environment. The characteristics of the bitumen also influence the potential for recovery and subsequent processing of the material. For example, saturated hydrocarbons contribute to the high pour points of recovered oils. The origin and composition of an oil influence its viscosity, API gravity, and coke formation during processing, particularly under low-temperature oxidation conditions. The objective of this work is to determine the chemical and physical properties of several samples of bitumen from geologically diverse tar sand deposits. The compound-type distributions and LTD properties of these bitumens are discussed relative to the depositional environment and processing potential of the organic matter.

7393 **Determination of geoporphyrins in Athabasca tar sands using semi-automated chromatographic deasphaltation.** Freeman, D.H.; Angeles, R.M.; Keller, S. (Dept. of Chemistry and Biochemistry, Univ. of Maryland, College Park, MD (US)). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **33**: No. 2, 231-238(Jun 1988). (CONF-880659—).

From ACS symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

A group separation procedure has been developed for the isolation of geoporphyrins from crude oil, oil sand bitumen and shale extract. For the first time, the major geoporphyrin subgroups are obtained reproducibly and relatively quickly. The present approach involves a systematic optimization of load capacity, fraction capacity and chemical sensitivity. The quality of the separations can be assessed by analyzing the geoporphyrins in the sub-group which are separated. Replicate measurements provide a check on method reliability. Repetitive measurements facilitate the statistical evaluations that are basic to the assessment of accuracy. The key analytical goals in this work were to achieve reliable and rapid methodology. The geoporphyrins are difficult to volatilize which makes the use of liquid chromatography, rather than gas, a logical approach. Liquid chromatography provides the major advantages of being gentle with the sample, and systematic multi-dimensional separations are easier to approach. In the initial steps which are being considered here, the sample-to-adsorbent ratio needs to be optimized. It should be as high as possible to gain sensitivity, and low enough to avoid an overload condition.

## 0406 Direct Uses And By-products

7394 **(FLC—8803) Preparation of pitch-water slurry. Final report.** Patroboy, T.J. (Farrington, Lockwood Co. Ltd., Kanata, Ontario (Canada)). 1988. 171p. (MICROLOG—88-05007). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An investigation of the effects of several commercial surfactants on the stability and rheology of aqueous slurries of hydrocracked pitch has been carried out. Also, limited studies of the effects of varying particle size distribution (PSD) and pitch concentration were conducted. A simple rod penetration test yielded a parameter (Aadj) that was very sensitive to the nature and concentration of surfactants examined in this work. Values of Aadj, obtained as a function of surfactant concentration, permitted the definition of a limited range of concentrations in which an optimum surfactant concentration is likely to be found. On this basis, the most effective surfactant will yield the lowest optimum surfactant concentration range. In general, anionic surfactants were more effective at dispersing pitch than nonionic surfactants. The surfactant concentration required to achieve a given degree of dispersal more than doubled when the pitch concentration was increased from 50 wt% to 60 wt%. The practical maximum concentration of pitch that can be incorporated into a slurry while maintaining optimum slurry behavior was established. In some cases, the amount of surfactant required to yield a given degree of dispersion increased as average PSD was reduced. Rheological measurements on the pitch slurries indicated that surfactants could dramatically reduce slurry viscosities; however, there was no apparent correlation between slurry rheology and static stability. Neither was there an obvious relationship between slurry rheology and the Aadj value. Intense ultrasound was evaluated as a method of dispersing pitch, but was not found likely to be effective. 151 refs., 37 figs., 21 tabs.

## 0410 Environmental Aspects

7395 **(N—88-29833) Effect of the near earth micrometeoroid environment on a highly reflective mirror surface.** Mirtich, M.J.; Mark, H.; Kerslake, W.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 40p. (NASA-TM—101307; E—4233; NAS—1.15:101307; CONF-880139—). NTIS, PC A03/MF A01.

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

A resurgence of interest in placing large solar concentrator solar dynamic systems in space for power generation has brought up again a concern for maintaining the integrity of the optical properties of highly specular reflecting surfaces in the near earth space environment. One of the environmental hazards needing evaluation is the micrometeoroid environment. It has been shown that highly reflective polished metals and thin film coatings degrade when exposed to simulated micrometeoroids in the lab. At NASA-Lewis, a shock tube was used to simulate the phenomenon of micrometeoroid impact by accelerating micron sized particles to hypervelocities. Any changes in the optical properties of surfaces exposed to this impact were then evaluated. The degradation of optical properties of polished metals and thin metallic films after exposure to simulated micrometeoroids was determined as a function of impacting kinetic energy area of the particles. A calibrated sensor was developed to not only detect the micrometeoroid environment, but also to evaluate the degradation of the optical properties of thin aluminum films in space. Results of the simulation are presented and discussed.

# 05 NUCLEAR FUELS

*REFER ALSO TO CITATION(S) 7791, 8604*

## 0501 Reserves, Exploration, And Mining

*REFER ALSO TO CITATION(S) 8473*

7396 **(FRCEA-TH—154) Electron paramagnetic resonance of the E'/sub 1/ center in quartz. Basic aspect and interest for uranium prospection and geology.** Chatagnon, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Institut National Polytechnique, 54 - Nancy (France)). Jan 1986. 351p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88756249/JAW.

Natural irradiation due to the presence of radioactve elements in the rocks leads to the formation of defects in the crystal lattice of minerals exposed to this irradiation. These irradiation-induced defects can subsist for a variable time period after the radioactive source has disappeared. They then act as a memory recording the irradiation of the mineral in its environment. The study of these defects allows one to extract this information and, at the same time, provides information about the radiation history of the rock or deposit. We have chosen to study quartz, a mineral found to be associated with the majority of uranium deposits and for which the behaviour under irradiation has been studied by physicists. The method of analysis used - Electron Paramagnetic Resonance (EPR) - is an extremely sensitive spectroscopic technique which provides unambiguous determination of the nature of an impurity or a paramagnetic defect in a solid. This technique, routinely used for the characterisation of defects, is relatively simple and rapid to apply when the observation conditions for the defect considered have been determined. By numerous analyses of samples of many origins we have been able to demonstrate the existence of a radiation-induced centre which is well adapted to recording of natural radioactivity and the passage of uranium mineralization events. This centre, called the E'/sub 1/ centre, is an intrinsic defect made up of an oxygen vacancy with a trapped electron. An experimental study of this defect has enabled us to determine its principal characteristics. Two uranium deposits have been studied in particular detail by this method: the Cluff D deposit (Saskatchewan, Canada) and the deposit at Bernardan in la Marche region, France.

7397 (IAEA-TECDOC—468, pp 19-25) **Essential subjects to be included into a uranium exploration and mining agreement.** Bourrel, J.; Bulling, E.; Fuchs, H.; Money, N.J. (Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy, Villacoublay (France); Uranerzbergbau G.m.b.H. und Co. K.G., Bonn (Germany, F.R.); Urangesellschaft m.b.H. und Co. K.G., Frankfurt am Main (Germany, F.R.); Prescribed Minerals and Materials Commission, Lusaka (Zambia)). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704484/JAW.

In Contractual arrangements for uranium exploration and mining.

The following subjects representing a check list are considered essential issues that require to be included in any uranium exploration and mining agreement. The check list, in addition provides recommendations and an outline of the underlying concepts for each contract item. Other items suitably tailored may be required to satisfy the particular legal and technical situation of the project and the special requirements of the parties involved. Exploration licence, financing of exploration expenditures, taxation, participation shares, imports, training of the local personnel, arbitration, technology transfer, etc. are among the important check list items.

7398 **Computer determination of calibration and environmental corrections for a natural spectral gamma ray logging system.** Koizumi, C.J. (Westinghouse Hanford Co., Richland, WA (US)). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 3: No. 3, 637-644(Sep 1988).

Pulse-height spectra recorded by a passive spectral gamma-ray logging system were simulated by radiation-transport calculations for several combinations of gamma ray sources and tool environments. Derived from the calculated log responses were (1) source- and energy-dependent environmental corrections and (2) calibration factors and an environmental correction method for three-window potassium/uranium/thorium analysis.

7399 **Adjustment of geochemical background data by multivariate statistics: application to NURE hydrogeochemical and stream sediment reconnaissance for uranium in the Hot Springs Quadrangle, South Dakota.** Zhou, D. Lawrence, KS; Univ. of Kansas (1984). 358p. University Microfilms Order No. 85-13,785.

Thesis (Ph. D.).

A method of background adjustment was developed and applied to geochemical reconnaissance data collected from the Hot Springs Quadrangle, South Dakota, as part of the National Uranium Resource Evaluation (NURE) program, sponsored by the United States Department of Energy. Source-rock lithology is found to be a dominant factor controlling the chemical composition of ground water or stream sediments. The most efficacious adjustment procedure is to regress uranium concentration on selected geochemical and environmental variables for each lithologic unit, and then to delineate anomalies by a common threshold set as a multiple of the standard deviation of the combined residuals.

## 0504 Feed Processing

7400 **(CNIC—00056) Reduction of uranium hexafluoride by carbon tetrachloride in the gaseous phase.** Xu Heqing; Qiu Lufu. (Tianjin Univ. (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 13p. (In Chinese). (TU—0002). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705025/JAW.

The reduction of UF/sub 6/ to UF/sub 4/ by CCl/sub 4/ in a 0.08 m diameter vertical glass reactor has been studied. In the tests, UF/sub 6/ and CCl/sub 4/, preheated to about 350 deg C, were fed into the reactor and the tower walls were held at about 500 deg C, the reaction was taking place almost completely in the gaseous phase. A high temperature flames can be visually observed by increasing in the reactant feed rates, and the brightness of the flame changes with the reactant feed rates. The conversion of UF/sub 6/ is essentially complete if a CCl/sub 4/ excess is maintained. The method is considered to be an effective process to meet continuous conversion of slightly enriched UF/sub 6/.

7401 **(CNIC—00059) Study of thermal decomposition kinetics of AUC in nitrogen by non-isothermal method.** Ge Qingren; Kang Shifang. (Tianjin Univ. (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 6p. (In Chinese). (TU—0005). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705027/JAW.

The thermal decomposition kinetics of AUC (Ammonium Uranyl Carbonate) in nitrogen has been determined by non-isothermal method. DSC curves are solved with computer by non-linear fitting method. The results show that the particle size has no apparent influence on decomposition rate, and the kinetics obeys Avrami-Erofeev equation within 90% conversion. The apparent activation energy and preexponent are found to be 105.5 kJcenter dotmol/sup -1/ and 2.17 x 10/sup 10/ s/sup -1/ respectively.

7402 **(CNIC—00060) Study of reactivity of uranium oxides: Pt.1. Uranium dioxide from UNH by one step denitration process.** Ge Qingren; Kang Shifang. (Tianjin Univ. (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 9p. (In Chinese). (TU—0006). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705028/JAW.

The reactivity of solid depends upon its structure. The structure of uranium dioxide prepared from uranyl nitrate hydrate by one step denitration process and the improvement of its reactivity have been studied. The results show that this material may be a kind of porous aggregates which consist of hard microspheres. It is activated by oxidation method and considerable efficacy can be obtained. The untreated material reacts with anhydrous HF at 500 deg C for 90 minutes and the hydrofluorination conversion is only

68%. The material treated by oxidation activated method and reduced again into uranium dioxide, reacts with 40% HF at 430 deg C for 35 minutes and the hydrofluorination conversion attains to 98%. The reactivity of the latter approaches to uranium dioxide via AUC.

## 0505 Uranium Enrichment

7403 **(CEA-CONF—9474) Spot analysis system by digitalization and imaging.** Gedin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). May 1988. 3p. (In French). (CONF-8805121—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755985/JAW.

From OPTO '88; Paris, France (17 May 1988).

Laser isotope separation experiments use series of laser producing several beams with characteristics adapted to physical conditions of photoionization. This paper describes briefly the laser chain and systems for measure and test with more details on analysis of spatial distribution of fluence and superposition of the three beams and alignment on the experiment axis.

7404 **(CEA-tr—2304) Laser isotope separation method.** Yoshida, I.; Kotani, K. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1988. 18p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756003/JAW.

Efficiency of uranium 235 separation is increased by separation not only of atoms at the fundamental level but also of atoms at the quasi-stable level in the uranium metal vapor.

7405 **(ENEA-RT-COMB—87-15) Reimiep 87. An interlaboratory U-235 enrichment determination by gamma measurement on solid UF/sub 6/ sample.** Aparo, M.; Cresti, P. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704683/JAW.

Gamma spectroscopy technique, based on the measurement of U/sup 235/ 186 KeV flux, is now currently used for the determination of Uranium enrichment in different material of nuclear fuel cycle, namely: Uranium metallic, UO/sub 2/ pellets, UF/sub 6/ liquid or solid. The present paper describes the use of such a technique and the obtained results in determining the U/sup 235//U atomic isotopic abundance on a certified UF/sub 6/ solid sample. The measurements have been carried out in the frame work of the participation to the "UF/sub 6/ Interlaboratory Measurements Evaluation Programme" organized by CBNM/Geel with the support of the ESARDA (European Safeguards Research and Development Association).

7406 **(PB—89-850523/XAB) Centrifuge enrichment plants. January 1970-October 1988 (Citations from the NTIS data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 90p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, control, monitoring, and safety of centrifuge enrichment plants. Power supplies, enrichment plant safeguards, facility design, cascade heater test loops to monitor the enrichment process, inspection strategies, and the socio-economic effects of centrifuge enrichment plants are examined. Radioactive waste disposal problems are briefly considered. (Contains 151 citations fully indexed and including a title list.)

## 0507 Fuels Production And Properties

7407 **(DPST—88-810) Powder metallurgy fuel fabrication: An evaluation.** Allender, J.S.; Charlesworth, D.P.; Hyder, M.L.; Leader, D.R.; Macafee, I.M.; Marra, J.E. (Savannah River Lab., Aiken, SC (USA)). Sep 1988. Contract AC09-76SR00001. 74p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004395/JAW.

This report summarizes the work of a Powder Metallurgy Task Team organized within the Savannah River Laboratory (SRL). The charter of this Task Team was to provide a "Position Paper" on the desirability of implementing the Powder Metallurgy (P/M) process as an FY-1992 Line Item Project at SRP. This P/M Project would replace a proposed project to replace casting furnaces for the current fuel fabrication process. Powder Metallurgy has been evaluated for SRP before. Much of the earlier work remains valid, and is only summarized here. Other issues are more current and are discussed in more detail. The report is organized into separate sections for each major topic. Two appendices show projections of fuel utilization for SRP reactors and an overview of economic studies. Two key issues are apparent. They relate to whether SRP will have a continuing need for a P/M process, and to questions about the reactor safety of the fuel. 81 refs.

7408 (INIS-SU—63, pp 24-28) **Track diffusion of gaseous fission products in uranium dioxide under irradiation.** Lemekhov, S.E.; Timashov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Influence of irradiation factors in uranium dioxide on temperature dependences of gaseous fission products volume diffusion coefficient, which account for track radiation-caused mechanisms of gaseous atoms transfer, is considered using ion explosion track model concept. Results of model calculations and comparisons with appropriate experimental data show, that at uranium dioxide irradiation under reactor conditions within temperature range up to 1800 degC transfer radiation-stimulated mechanisms may play determining role in gaseous fission products volume diffusion in fuel.

## 0508 Spent Fuels Reprocessing

*REFER ALSO TO CITATION(S) 7407, 7465*

7409 **(CEA-CONF—9412) Corrosion resistance of metallic materials for use in nuclear fuel reprocessing.** Pinard Legry, G.; Pelras, M.; Turluer, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques). 1988. 2p. (CONF-8802126—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756116/JAW.

From Dechema Working Session Party on Process Engineering for Nuclear Fuel Reprocessing; Frankfurt, F.R. Germany (19 Feb 1988).

The main of this review is to reassess the corrosion resistance properties required from metallic materials to be used in the various developments of the Purex process applied for nuclear fuel reprocessing.

7410 **(CNIC—00084) Investigation of the gas formation in dissolution process of nuclear reactor fuel.** Zhang Qinfen; Liao Yuanzhong; Chen Yongqing; Sun Shuyun; Fan Yincheng. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Dec 1987. 6p. (In Chinese). (IAE—0024). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705039/JAW.

The gas formation in dissolution process of two kinds of nuclear fuels was studied. The results shows that the maximum volume flow released from dissolution system is composed of two parts. One of them is air remained in dissolver and pushed out by acid vapor. The other is produced in dissolution reaction. The procedure of calculating the gas amount produced in dissolution process has been given. It is based on variation of components of dissolution solution. The gas amount produced in dissolution process of spent UO/sub 2/ fuel elements was calculated. The condenser system and loading volume of disposal system of tail gas of dissolution of spent fuel were discussed.

## 0509 Transport And Storage

*REFER ALSO TO CITATION(S) 7474, 9079*

**7411 (CAPE—1662-Rev.1-Suppl.1) Horizontal loading shipping containers for 30 inch diameter $UF_6$ tanks (Engineering Materials).** Stout, F.W. Jr.; Lay, G.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 6 Apr 1988. Contract AC05-84OT21400. 8 H. Order Number TI89003517/JAW.

8 35-mm aperture cards.

This publication contains 8 aperture cards with design specifications for horizontal loading shipping containers used to carry 30" diameter $UF_6$ tanks. (JF)

**7412 (CRIE-U—87049) Estimation of integrity of cast-iron cask against impact due to free drop test (Part 1). Estimation for brittle failure by analysis.** Ito, Chihiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755718/JAW.

About a ductile cast iron cask expected for a shipping or storage container of spent nuclear fuel, an estimation method based on linear fracture dynamics was proposed for brittle failure due to drop impact, and its analysis results by the method were showed. Based on home and foreigh technical standards and brittle failure estimation methods for cast iron and the MITI(Ministry of International Trade and Industry)'s notice applied to the design of nuclear power plant facilities in Japan, the method was prepared considering the nature of cast iron. From the analysis, a critical flaw depth (the minimun depth to initiate brittle failure) was deeper than an allowable flaw depth (the detectable maximum depth in destructive inspection). And also the method assumed a cast iron cask modeled on the shape and size of a existing cask, and used the values on the safety side for material characteristics. Consequently, the integrity of a cast iron cask for brittle failure might be expected from the analysis results by the method. (27 figs, 3 tabs, 6 refs)

**7413 (PNL—6727) 1988 Federal Interim Storage Fee study: A technical and economic analysis.** (Johnson (E.R.) Associates, Inc., Oakton, VA (USA)). Nov 1988. Contract AC06-76RL01830. 152p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004149/JAW.

This document is the latest in a series of reports that are published annually by Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE). The information in this report, which was prepared by E.R. Johnson Associates, Inc., under subcontract to PNL, will be used by the DOE to establish a payment schedule for interim storage of spent nuclear fuel under the Federal Interim Storage (FIS) Program. The FIS Program was mandated by the Nuclear Waste Policy Act of 1982. The information will be used to establish the schedule of charges for FIS services for the year commencing January 1, 1989. 13 refs.

## 0510 Marketing, Economics, And By-products

*REFER ALSO TO CITATION(S) 10595*

## 0520 Waste Management

*REFER ALSO TO CITATION(S) 7496, 7496, 7497, 7499, 7915, 8161, 8385, 8407, 8566, 9395, 9400, 9617, 9622, 10123*

**7414 (AECL—7083) Program for evolution from storage to disposal of radioactive wastes at CRNL.** Dixon, D.F. (ed.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1985. 64p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88704975/JAW.

This report reviews past and current radioactive waste management practices at the Chalk River Nuclear Laboratories (CRNL) and outlines the proposed future program. For nearly 40 years, radioactive wastes have been generated at CRNL and have also been received there on a continuing basis from hospitals, industries, universities and miscellaneous other sources across Canada. The solid wastes now at CRNL have been either stored or buried and their total consolidated volume is approaching 50 000 m/sup 3/ . Much of that waste will require disposal as will the future wastes of similar character. The waste management program plan describes the proposed development of safe disposal facilities which could be built on site to accommodate most, if not all, of the radioactive wastes for which CRNL has responsibility. Three reference disposal concepts, each potentially capable of accepting a portion of the wastes, are described. One of these, the intrusion-resistant shallow land burial (SLB) concept, could be suitable for disposal of most of the CRNL wastes. It is proposed that a prototype SLB facility be designed, constructed and operated on the CRNL property and filled by 1992 to provide a focus for disposal research and development programs and to accumulate experience in all aspects of waste management. 53 refs.

**7415 (BMI/ONWI/C—122) Status of the compact disk-read only memory feasibility study: Draft letter report.** Peters, H.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). [1987]. Contract AC02-87CH10290. 36p. H. Order Number TI89000076/JAW.

Presently available literature (late 1985/early 1986) indicates that significant progress has been made recently in advancing the state-of- the-art in the field of optical of information. If this technology could be applied to the information management task on the Salt Repository Project, several significant advantages are apparent. Among them is the fact that optical memory devices have an essentially indefinite storage life. Although the archival and transportability advantages alone would probably justify the use of this medium, it is also important to investigate its usability in the information retrieval mode. It would be of little or no value to store project data on these disks if recovering the information was difficult or inaccurate. As of this date, the project has no way of employing the tremendous data processing powers of computers for the storage and retrieval of the full text of our document. On a program that is as document-intensive as the Salt Repository Project, a large percentage of the total person-hours are spent in either creating or using the project documentation. If such a capability were available, it is estimated that thousands of person-hours could be saved in the prelicense and licensing phases of the project alone, not only for project personnel, but also for monitoring and approving organizations such as DOE-HQ, the NRC, Congress, and State agencies. 40 refs., 11 figs.

**7416 (BMI/ONWI/C—240) NX borehole jack testing procedure: Final draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Aug 1986. Contract AC02-87CH10290;AC02-83CH10140. 98p. H. Order Number TI88016458/JAW.

NX borehole jack (Goodman jack) tests will be performed to estimate the in situ modulus of deformation of non-salt strata within or adjacent to the test horizon and in allocated areas from the exploratory shafts. This information, together with the results from other types of deformation modulus measurements, will be part of the database used to select rock mass modulus values for input to numerical models which evaluate the large-scale thermomechanical response of the host rock and surrounding strata at the candidate repository site. Because salt possesses significant and complex time-dependent behavior, the NX borehole jack test is not suitable for determining the deformational properties of this material. The main advantage of this test are (1) modulus can be measured at a large distance from the underground opening, outside of the disturbed zone, as well as near the opening surface, and (2) because the jack applies load across a diameter, as opposed to radially, the anisotropy of deformational properties can be investigated. Unlike most other in situ tests for determining modulus of deformation, the NX borehole jack is relatively portable, easy to set up, and produces test results fairly rapidly. For these reasons, this test is well-suited to conveniently provide a large number of measurements from many locations. 7 refs., 10 figs., 1 tab.

7417 **(BMI/ONWI/C—306) High level nuclear waste repository in salt: Sealing systems status and planning report: Draft report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Engineers, Inc., Irvine, CA (USA). Advanced Technology Div.). Sep 1985. Contract AC02-87CH10290;AC02-83WM46656. 282p. H. Order Number TI89000043/JAW.

This report documents the initial conceptual design studies for a repository sealing system for a high-level nuclear waste repository in salt. The first step in the initial design studies was to review the current design level, termed schematic designs. This review identified practicality of construction and development of a design methodology as two key issues for the conceptual design. These two issues were then investigated during the initial design studies for seal system materials, seal placement, backfill emplacement, and a testing and monitoring plan. The results of these studies have been used to develop a program plan for completion of the sealing system conceptual design. 60 refs., 26 figs., 18 tabs.

7418 **(BMI/OWTD—3) Technology needs for selecting and evaluating high-level waste repository sites in crystalline rock.** (Battelle Memorial Inst., Willowbrook, IL (USA). Office of Waste Technology Development; Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1988. Contract AC02-83CH10139. 310p. NTIS, PC A15/MF A01 - OSTI. Order Number DE89004721/JAW.

This report describes properties and processes that govern the performance of the geological barrier in a nuclear waste isolation system in crystalline rock and the state-of-the-art in the understanding of these properties and processes. Areas and topics that require further research and development as well as technology needs for investigating and selecting repository sites are presented. Experiences from the Swedish site selection program are discussed, and a general investigation strategy is presented for an area characterization phase of an exploratory program in crystalline rocks. 255 refs., 65 figs., 10 tabs.

7419 **(CEA-CONF—9429) Scale effect in lixiviation.** Billon, A.; Nomine, J.C.; Deyson, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1988. 4p. (CONF-880510—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756117/JAW.

From IAEA-ECC international symposium on the management of low and intermediate level radioactive wastes; Stockholm, Sweden (16 May 1988).

The confinement power of a waste package is one of the major characteristics to be considered for the storage safety. This confinement power is generally determined by lixiviation tests. These tests are generally made on little dimensions samples. The present study concerns the stature effect extrapolation.

7420 **(CEA-CONF—9487) Programme of quality assurance relative to management and characterization of low activity wastes of Saclay nuclear study center.** Cordero, G.; Perotin, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements). May 1988. 12p. (In French). (CONF-880510—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755986/JAW.

From IAEA-ECC international symposium on the management of low and intermediate level radioactive wastes; Stockholm, Sweden (16 May 1988).

The technique for inspection and characterization of solid wastes with a low or very low $\alpha$ activity and medium $\beta$ or $\gamma$ activity allows to guarantee ANDRA, the collecting authority, an accurate, but not perfect, knowledge of the wastes and to limit the risk of non-compliance to technical prescription to an acceptable value. Choice of sampling technique limits the number of analysis and automation limits cost and personnal risks.

7421 **(CONF-880631—58) Graded approach for eastablishment of QA [quality assurance] requirements for type B packaging of radioactive material.** Fabian, R.R.; Woodruff, K.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003983/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

A study that was conducted by the Nuclear Regulatory Commission for the US Congress to assess the effectiveness of quality assurance (QA) activities has demonstrated a need to modify and improve the application of QA requirements for the nuclear industry. As a result, the packaging community, along with the nuclear industry as a whole, has taken action to increase the efficacy of the QA function. The results of the study indicate that a graded approach for establishing QA requirements is the preferred method. The essence of the graded approach is the establishment of applicable QA requirements to an extent consistent with the importance to safety of an item, component, system, or activity. This paper presents the process that is used to develop the graded approach for QA requirements pertaining to Type B packaging.

7422 **(CONF-880839—11) Methodology for assessing performance of waste management systems.** Meshkov, N.K.; Herzenberg, C.L.; Camasta, S.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003658/JAW.

From Annual DOE low-level waste management conference; Denver, CO, USA (30 Aug 1988).

The purpose of the methodology provided in this report is to select the optimal way to manage particular sets of waste streams from generation to disposal in a safe and cost-effective manner. The methodology described is designed to review the entire waste management system, assess its performance, ensure that the performance objectives are met, compare different LLW management alternatives, and select the optimal alternative. The methodology is based on decision analysis approach, in which costs and risk are considered for various LLW management alternatives, a comparison of costs, risks, and benefits is made, and an optimal system is selected which minimizes costs and risks and maximizes benefits. A "zoom-lens" approach is suggested, i.e., one begins by looking at gross features and gradually proceeds to more and more detail. Performance assessment requires certain information about the characteristics of the waste streams and about the various components of the waste management system. Waste acceptance criteria must be known for each component of the waste management system. Performance assessment for each component requires data about properties of the waste streams and operational and design characteristics of the processing or disposal components. 34 refs., 2 figs., 1 tab.

7423 **(CONF-881054—38) A tracking system for hazardous waste minimization.** Martino, L.E.; Chiu, Shen-Yann; Peters, R.W.; Wentz, C.A.; Habegger, L.J.; Donahue, B. (Argonne National Lab., IL (USA)). [1988]. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003971/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

A successful waste minimization program must include the development of a reliable system for tracking waste types, volumes, and generation points. Once such a system is in place, process engineers should be capable of developing minimization alternatives to achieve the program goals. This study involved the development of a waste tracking system based on bar code technology. The tracking system utilizes a dBase III Plus data base and a software program known as "Barcode." The program assigns a bar code to each hazardous material container at the time of receipt for use in keeping track of its location at the facility. Bar codes can be similarly assigned for hazardous wastes at the time of generation. Handheld bar code readers are then used to read the labels whenever the items are shipped, received, or used. This tracking system differs from other commercially available tracking systems in that it permits collection of data at the unit operation level as well as at a plantwide level. 3 refs., 2 figs., 4 tabs.

7424 **(DOE/CH/10139—4(86-87)) Repository Technology Program: Technical progress report for the period May 29, 1986--June 30, 1987.** (Battelle Memorial Inst., Willowbrook, IL (USA). Office of Waste Technology Development). Oct 1988. Contract AC02-83CH10139. 32p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004738/JAW.

This document reports the progress made in the 13-month period from May 29, 1986--June 30, 1987, on the development of a second geologic repository in rocks other than those being considered for a first repository. Subsequent periods will be covered in reports to be issued on a semiannual basis. The reporting elements are arranged by the work breakdown structure so that related studies are presented together. The studies are reported by the Office of Waste Technology Development (OWTD), a prime contractor of the US. Department of Energy (DOE) Repository Technology Program (RTP) Office in the Repository Technology and Transportation Division (RTTD) of the Office of Geologic Repositories (OGR). The studies include work by other DOE prime contractors and by contractors to the OWTD. 50 refs.

7425 **(DOE/CH/10139—T33) DOE hearing on the draft area recommendation report for the Crystalline Repository Project, Ironwood Theater, Ironwood, Michigan, April 10, 1986: Transcript of proceedings.** (Battelle Memorial Inst., Columbus, OH (USA)). 1986. Contract AC02-83CH10139. 135p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89002592/JAW.

This document contains a transcript of the comments of 22 witnesses. These meetings were held to hear public comments regarding the selection of a site for a second high-level nuclear waste repository. TEM

7426 **(DOE/CH/10290—T1) Interface management for the Yucca Mountain Project.** (Battelle Memorial Inst., Columbus, OH (USA). Project Management Div.). Dec 1988. Contract AC02-87CH10290. 106p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89005005/JAW.

The subject of this report is selection of that portion of physical and informational interfaces that need to be controlled on the Yucca Mountain Project (YMP). Physical interfaces are interactions between physical elements of the mined geologic disposal system; for example, the repository shafts will interface with the shafts in the Exploratory Shaft Facility (ESF), because the ESF shafts will eventually be absorbed into the repository as additional repository shafts. Informational interfaces are interactions involving an exchange of information between organizations working on the mined geologic disposal system; for example, the in situ testing contractor will interact with the site performance assessment contractor and will supply information regarding host rock behavior. This report describes the physical system interfaces that can be identified from analysis of a physical system structure. A discussion of informational interfaces can be found elsewhere. 30 refs., 8 figs., 3 tabs.

7427 **(DOE/DP/48010—T2) Minutes of the first, second, and third meeting of the Panel for Continuing Review and Assessment of the ORNL Hydrofracture Technique (WMPORMOD), August 6--7, 1985; November 5-6, 1985; October 6, 1986, Oak Ridge National Laboratory, Oak Ridge, Tennessee: [Quarterly progress report, October--December 22, 1986].** (National Research Council, Washington, DC (USA). Commission on Physical Sciences, Mathematics, and Resources). 1986. Contract AC01-83DP48010. 53p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89002727/JAW.

The open session began at 0945 with a brief discussion by Dr. Steven H. Stow of desirable clarifications in several areas of the text appearing in chapter 9 of the Management of Radioactive Waste at the Oak Ridge National Laboratory: A Technical Review (National Academy Press, 1985). The ORNL staff points were well taken, and generally consistent with the understandings of the panel members who had drafted the report sections. Material was then presented by ORNL staff included Review of information collected since the October 1984 briefing, Plans for Deep Monitoring Well Groundwater Sampling and Monitoring, Plans for the Knox Reconnaissance Well, Waste Sampling and Analysis, Regulatory Interfaces and the Permitting Process, and Alternatives to Hydrofracture. Each of the presentations was summarized in a handout.

7428 **(DOE/HWP—63) Waste acid detoxification and reclamation: Final Phase II report: Summary of distillation and material degradation tests for FY 1987 and FY 1988.** Brouns, T.M.; Stewart, T.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 39p. (PNL—6631). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004768/JAW.

The objective of the Waste Acid Detoxification and Reclamation project is to develop processes for reducing the volume, quantity, and toxicity of metal-bearing waste acids. The primary incentives for implementing these types of waste minimization processes are regulatory and economic (that is, to meet requirements in the Resource Conservation and Recovery Act and reduce the cost for treatment, storage, and disposal). Two precipitation processes and a distillation process are being developed to minimize waste from fuel fabrication operations or other metal-finishing operations conducted at US Department of Energy Defense Programs (DOE-DP) facilities. Waste process acids such as (1) HF-$HNO_3$ etch solutions containing Zr as a major metal impurity, and (2) $HNO_3$ strip solutions containing Cu as a major metal impurity are detoxified and reclaimed by concurrently precipitating heavy metals and regenerating acid for recycle. Acid from a third waste acid stream generated from chemical milling operations is reclaimed by the use of distillation. This stream comprises $HNO_3$ and $H_2SO_4$ containing U as the major metal impurity. Distillation allows $NO_3$/sup {minus}/ to be displaced by $SO_4$/sup {minus}2/ in metal salts; free $HNO_3$ is then vaporized from the U-bearing sulfate stream. In a downstream precipitation step, uranium can be recovered from the sulfate stream. This report summarizes distillation tests and candidate material degradation tests conducted during FY 1987 and FY 1988.

7429 **(DOE/HWP—64) Kinetics and mechanism of methane oxidation in supercritical water.** Rofer, C.K.; Streit, G.E. (Los Alamos National Lab., NM (USA); Oak Ridge National Lab., TN (USA)). Oct 1988. Contract W-7405-ENG-36;AC05-84OR21400. 27p. (LA—11439-MS). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004294/JAW.

This project, is a Hazardous Waste Remedial Actions Program (HAZWRAP) Research and Development task being carried out by the Los Alamos National Laboratory. Its objective is to achieve an understanding of the technology for use in scaling up and applying oxidation in supercritical water as a viable process for treating a variety of Department of Energy Defense Programs (DOE-DP) waste streams. This report presents experimental results for the kinetics of the oxidation of methane and methanol in supercritical water and computer modeling results for the oxidation of carbonmonoxide and methane in supercritical water. The experimental and modeling results obtained to date on these one-carbon model compounds indicate that the mechanism of oxidation in supercritical water can be represented by free-radical reactions with appropriate modifications for high pressure and the high water concentration. If these current trends are sustained, a large body of existing literature data on the kinetics of elementary reactions can be utilized to predict the behavior of other compounds and their mixtures. 7 refs., 4 figs., 3 tabs.

7430 **(DOE/LLW—69T) The 1987 state-by-state assessment of low-level radioactive wastes received at commercial disposal sites: National Low-Level Radioactive Waste Management Program.** Tyron-Hopko, A.K.; Ozaki, C.B. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1988. Contract AC07-76ID01570. 134p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004974/JAW.

The Low-Level Waste Management Program has published nine annual State-by-State Assessment Reports since 1979. These reports provide both national and state-specific disposal data on low-level radioactive wastes. Data in this report are divided into generator categories, waste classes, volumes, and activities. Included in this report are tables showing a distribution of wastes by state for 1987 and a comparison of waste volumes by state for 1983 through 1987; also included is a list of all commercial nuclear power reactors in the US as of December 31, 1987. 8 refs.

7431 **(DOE/NV/10322—33) Selected stratigraphic contacts for drill holes in LANL use areas of Yucca Flat, NTS.** Drellack, S.L. Jr. (Fenix and Scisson, Inc., Mercury, NV (USA)). Jul 1988. Contract AC08-84NV10322. 55p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89003805/JAW.

This report is a compilation of selected stratigraphic contacts in drill holes of Yucca Flat, Nevada Test Site (NTS), used by the Los Alamos National Laboratory (LANL), This is the product of an ongoing effort to establish and maintain the most up-to-date database of formation tops in LANL use areas of Yucca Flat. Figure 1 is an index map showing areas of the NTS covered in this report. A drill hole planning map showing hole locations is in the rear pocket. Data presented for each drill hole include drill hole name; year drill hole completed; ground level elevations, above mean sea level (MSL), at drill hole site; total depth (TD) of drill hole at completion of drilling; and depth below surface to selected stratigraphic contacts. The geologic data presented here was generated by numerous individuals. Published references, from which most of these data originated, are listed on page 54 of this report. Information regarding other drill hole statistics can be fund in the NTS Drilling and Mining Summary ("The Redbook") compiled by the Technical Support Division of Fenix and Scisson, Inc. We continue the "revised" stratigraphic nomenclature for the bedded tuffs between the Rainier Mesa Member of the Timber Mountain Tuff and the Grouse Canyon Member of the Belted Range Tuff (formerly the "Paintbrush Tuff"). Confidence in these stratigraphic assignments for these bedded tuffs is consolidating. 13 refs., 4 figs., 2 tabs.

7432 **(DOE/RW—0198) Site characterization plan overview: Yucca Mountain site, Nevada Reserch and Development Area, Nevada.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1988. 172p. H. Order Number TI89004612/JAW.

To help the public better understand both the SCP and the site characterization program, the DOE has prepared this overview and the SCP Public Handbook. The overview presents summaries of selected topics covered in the SCP; it is not a substitute for the SCP. The organization of the overview is similar to that of the SCP itself, with brief descriptions of the Yucca Mountain site, the repository, and the containers in which the waste would be packaged, followed by a discussion of the characterization program to be carried out at the Yucca Mountain site. This overview is intended primarily for those persons who want to understand the general scope and basis of the site-characterization program, the activities to be conducted, and the facilities to be constructed without spending the time necessary to become familiar with all of the technical details presented in the SCP. For the readers of the SCP, the overview will be useful as a general guide to the plan. The SCP Public Handbook is a short document that contains brief descriptions of the SCP process and the contents of the SCP. It also explains how the public can submit comments on the SCP and lists the libraries and reading rooms at which the SCP is available. 9 refs., 18 tabs.

7433 **(DOE/RW—0205) Section 175 report: Secretary of Energy report to the Congress pursuant to Section 175 of the Nuclear Waste Policy Act, as amended.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1988. 138p. H. Order Number TI89004438/JAW.

This report contributes to, but does not supplant, ongoing studies being conducted by DOE to ensure that potentially significant adverse effects that may result from the repository program are minimized to the maximum extent practicable. As indicated in the Environmental Assessment for the Yucca Mountain site (US DOE, 1986) DOE does not believe significant adverse effects will result from site characterization activities. Nevertheless, DOE is conducting a variety of studies to determine if this conclusion is valid. These studies include, but are not limited to, monitoring of air and water quality and other environmental factors; monitoring the number of inmigrating repository program workers and their residential locations; identifying cultural resources in the Yucca Mountain area and traditional culture and religious values of American Indian people associated with those resources; evaluating possible rail access routes to the Yucca Mountain site; and evaluating possible highway routes. These studies have been implemented after consultation with affected parties in Nevada. As part of the determination of suitability, and Environmental Impact Statement will be written and will include an analysis of potential impacts associated with constructing, operating, closing, and decommissioning a repository at Yucca Mountain, Nevada. 59 refs., 33 figs., 12 tabs.

7434 **(DOE/WIPP—86-009) Silicon-controlled rectifier failure investigation report, April 11 and May 7, 1986, Type A occurrence.** (Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div.). 10 Oct 1986. Contract AC04-86AL31950. 147p. NTIS, PC A07 - OSTI. Order Number DE89003544/JAW.

As a result of the April 11, 1986 failure and subsequent property damage of the silicon-controlled rectifier (SCR) device used to provide dc power to the motor driven construction and salt handling (C&SH) hoist at the Waste Isolation Pilot Plant (WIPP), the Project Manager, WIPP Project Office, appointed an Accident Investigation Board on April 14, 1986. The Board was tasked to investigate, to determine the cause or causes of the SCR failure, and to make appropriate recommendations to prevent a recurrence. Subsequently, the scope of the investigation was expanded on April 22, 1986, to include a series of failures that occurred after the initial failure. This occurrence came after the SCR had been released by the Board, repaired, modified, and returned to use. The investigation included a review of the engineering, procurement, operations, and maintenance programs of the Management and Operating Contractor (MOC), along with a detailed investigation of the hardware involved in the failure. Analytical techniques included use of the Management Oversight Risk Tree (MORT) and Events and Causal Factors Sequence Charting. 15 figs.

7435 **(DOE/WIPP—88-030) Hydrostatic pressure and fluid-density distribution of the Culebra Dolomite member of the Rustler Formation near the Waste Isolation Pilot Plant, southeastern New Mexico.** Crawley, M.E. (Westinghouse Electric Corp., Carlsbad, NM (USA). Engineering and Repository Technology Dept.). May 1988. Contract AC04-86AL31950. 157p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89003550/JAW.

The primary objectives of the Pressure - Density Survey were to obtain the middle-of-formation pressures, determine well-bore fluid densities, define well-bore fluid density stratification, and to provide, where possible, formation water density values for wells where little or no information on densities exists. The survey collected ground-water pressure and density data during three field testing periods during the years 1986 and 1987. Data were collected from 33 individual wells located in the vicinity of the WIPP Site. 18 refs., 10 figs., 10 tabs.

7436 **(DPST—86-469) Decontamination of Purex waste from tank S-27.** Selby, C.L. (Savannah River Lab., Aiken, SC (USA)). 30 May 1986. Contract AC09-76SR00001. 7p. NTIS, PC A02 - OSTI. Order Number DE89003802/JAW.

Purex spent solvent stored in tank S-27 may not be burned in the Beta Gamma Incinerator because it contains excessive alpha and beta-gamma emitting contaminants for which the BGI has insufficient shielding and containment. SRL was asked to recommend a process for removing these contaminants and to assist in building a processing plant. A laboratory scale multivariant study showed that washing the Purex (organic) with 1.0 molar nitric acid (aqueous) at organic/aqueous ratio 5 reduced contamination from 500,000 to 50,000 d/m/ml alpha while minimizing contaminated aqueous generation. Mixing for sixteen hours followed by two hours settling was optimal though four hours mixing was sufficient with 1.0 molar nitric acid. A plant consisting of a 3000 gallon mix tank with a funnel base and a 500 gallon aqueous makeup tank is recommended. Sodium carbonate solid or solution is recommended to neutralize the processed organic and aqueous. 2 refs., 3 figs., 7 tabs.

7437 **(DPST—86-507) Savannah River solid radioactive waste forecast, FY 1986.** Thomas, S.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1986. Contract AC09-76SR00001. 29p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003796/JAW.

The 1986 Solid Waste Forecast considers two types of waste: nonretrievable and retrievable (transuranic) waste. The effect of new facilities (DWPF, Naval Fuels, etc.) beginning operation coupled with plant-wide efforts to compact or reduce the volume of waste sent to 643-7G will tend to stabilize the solid waste generation rate over the forecast period (CY 1986--1995). Volume reduction by incineration and compaction, which is expected to increase during the forecast period, could reduce the volume of nonretrievable waste requiring burial by 50%. The volume of transuranic (TRU) waste generated each year is expected to increase to approximately 32,000 $ft^3$/yr in 1987 and then decrease and stabilize at 17,000 $ft^3$/yr TRU during the forecast period. A program is underway to process and dispose of all retrievably stored TRU waste and newly generated waste over approximately a 16-year period beginning in 1993. This program will reduce the amount of waste that must be shipped to the Waste Isolation Pilot Plant (WIPP) for permanent disposal and process that waste which is not certifiable for the WIPP. 9 figs., 7 tabs.

7438 **(DPST—86-660) Stoichiometry for radiolysis of MTPB for CPES flowsheet calculations.** Fowler, J.R. (Savannah River Lab., Aiken, SC (USA)). 9 Sep 1986. Contract AC09-76SR00001. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003462/JAW.

CsTPB, NaTPB and $NH_4$TPB in addition to the KTPB shown in your note are present in precipitate slurry. CPES flowsheet calculations require physical properties for any component that is used in calculations. The stoichiometry that you show would require the addition of 12 new organic salt components to our data base--3 for each of the MTPB salts that undergo radiolysis. For CPES material balance calculations, I will use the stoichiometry shown in Table I with the accompanying percent reactions shown for each of the reactions. This stoichiometry will add two components to the flowsheet calculations--phenol salt and phenylboric acid salt--without altering the quantities of the major products. Table II compares this stoichiometry to your data given in the reference DSI-WI. Properties used for these components would be identical to the parent organic acids with the elimination of vapor pressure data to avoid volatilization during air purges of tanks. Use of the resulting material balance would require the use of salts ($Na^+$ or $K^+$) if simulated slurries were to be prepared.

7439 **(DPST—87-713) Projected chemical compositions of SRP waste glass for the waste acceptance preliminary specifications.** Fowler, J.R. (Savannah River Lab., Aiken, SC (USA)). 22 Mar 1988. Contract AC09-76SR00001. 39p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004394/JAW.

Using the Integrated Flowsheet Model of waste processing at the Savannah River Plant and the proposed waste processing schedule, the projected chemical compositions of four waste glasses to be produced from existing high-activity waste inventory have been calculated. These glasses represent the expected compositions of glasses to be produced in the Defense Waste Processing Facility (DWPF) through at least the first eight years of DWPF operation. Compositions of three hypothetical glasses have also been calculated that represent glasses produced from: an overall blend of existing inventory; a blend of HM (high aluminum) waste that represents the upper design limit of glass viscosity that will be processed in the DWPF glass melter; and a blend of Purex (high iron) waste that represents the lower design limit of glass viscosity that will be processed in the DWPF glass melter. These latter two compositions should bracket the range of chemical compositions for SRP waste glass that could be produced using present DWPF technology and process limits.

7440 **(DPST—87-777) Transferring frit slurry through a Ronningen-Petter slurry filter.** Trinh, T.T. (Savannah River Lab., Aiken, SC (USA)). 21 Sep 1988. Contract AC09-76SR00001. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003837/JAW.

A prototypic DWPF (Defense Waste Processing Facility) frit-slurry vibrating filter was tested with 40 to 60 wt % frit/water slurry and was found to be operable. Results of testing confirm a need for flushing after a transfer is made.

7441 **(EGG-WM—8181) Materials evaluation in the WERF [Waste Experimental Reduction Facility] low-level radioactive waste incinerator off-gas system.** Smolik, G.R.; Dalton, J.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1988. Contract AC07-76ID01570. 52p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004869/JAW.

Performances of alloys in a low-level radioactive, combustible waste incinerator were evaluated. Test coupons and an extracted heat exchanger tube were examined to provide information on alloy behavior in the off-gas system of this facility. Type 316 stainless steel, the alloy of which the heat exchanger is constructed, was most extensively examined. Coupons exposed upstream of the heat exchanger exhibited high temperature corrosion rates of {approximately}100 mpy (incinerator operation time). The rate observed from the heat exchanger tube was lower, {approximately}25 mpy. A 10 year lifetime would be expected based upon this mode of attack and continued similar operating parameters and waste composition. Other alloys were tested to identify potential replacement candidates. Alloys displaying lower metal loss rates at the location upstream of the heat exchanger included HDA 8727 (7 mpy), Alloy 800H (37 mpy), Haynes 230 (50 mpy), and Type 310 stainless steel (63 mpy). The relatively long term exposures (spanning over 4250 hrs of operation) and controlled waste composition makes this information pertinent to the waste incineration community as well as the WERF program. 15 refs., 18 figs., 11 tabs.

7442 **(EGG-WM—8289) Plutonium contamination control studies during a glove box scale simulated excavation of TRU buried waste.** Shaw, P.G.; Loomis, G.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1988. Contract AC07-76ID01570. 25p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004871/JAW.

A series of glove box scale excavation experiments were performed to investigate contamination control during retrieval operations. The glove box apparatus was constructed of plexiglass with three glove ports and a removable/sealable lid. A soil block that was spiked with dysprosium as a plutonium analog was used in glove box tests. Test variables in the glove box experiments included soil moisture content and excavation techniques (dig rate and degree of vigorousness). Instrumentation to measure airborne concentrations of both respirable and nonrespirable particles included five EPA low volume cyclone sampling systems. Both small respirable particles and larger nonrespirable particles were activated in a reactor and counted to determine dysprosium content in tests conducted. 5 refs., 4 figs., 6 tabs.

7443 **(EGG-WM—8298) Buried Waste Program Retrieval Process Model prototype.** Heiser, D.L.; Fogdall, S.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-76ID01570. 70p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89003661/JAW.

The Buried Waste Program Retrieval Process Model (BWP-RPM) prototype was designed to provide system performance estimates, and assist the decision making process in the retrieval phase of the Buried Waste Program. The model was developed to address queueing, scheduling, materials handling, and transportation problems. A functional model of the proposed retrieval operations formed the basis of the conceptual design. From the foundation formed by the functional model, the simulation model was constructed. The simulation model is presented through a brief description of the selected simulation language and then its application to the BWP-RPM. Detailed listings of the simulation code, and model output are included. 2 figs., 2 tabs.

7444 **(FMPC—2066) T-hopper shipping container handling procedures and container criteria.** Lawson, K.A. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 31 Aug 1987. Contract AC05-86OR21600. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004396/JAW.

This report has been prepared to describe the T-Hopper Shipping Container, its use and handling procedures. The information herein details essential elements required for transportation of T-hoppers from one DOE facility to another, including the Department of Transportation (DOT) rules and regulations regarding the

shipment of radioactive materials having low specific activity (LSA). The DOT standards have been incorporated in this document in the form of packaging, radiation monitoring, smear testing, cleaning and inspection requirements. T-hoppers are presently utilized at Rockwell-Hanford Operations (RHO), Richland, Washington, for transporting uranium trioxide (UO3) to the Feed Materials Production Center (WMCO), Fernald, Ohio. Uranium trioxide (UO3) is reduced to uranium tetrafluoride (UF4) at the FMPC by means of the hydrofluorination process. T-hoppers are also utilized at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, to ship depleted uranium tetrafluoride (UF4) or "greensalt" to the FMPC for reduction to uranium metal. 5 figs.

7445 **(IFE/KR/E—88/002) Treatment and storage of radioactive wastes at Institute for Energy Technology, Kjeller, Norway and a short survey of non-radioactive hazardous wastes in Norway.** Lundby, J.E. (Institute for Energy Technology, Kjeller (Norway)). Aug 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755662/JAW.

The treatment and storage of low-level and intermediate-level radioactive wastes in Norway is described. A survey of non-radioactive hazardous wastes and planned processing methods for their treatment in Norway is given. It seems that processing methods developed for radioactive wastes to a greater extent could be adopted to hazardous wastes, and that an increased interdisciplinary waste cooperation could be a positive contribution to the solution of the hazardous waste problems.

7446 **(INIS-BR—1302) Simplified computer code based on point Kernel theory for calculating radiation dose in packages of radioactive material.** (Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ. Dept. de Instalacoes e Materiais Nucleares). Mar 1986. 56p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704541/JAW.

A study on radiation dose control in packages of radioactive waste from nuclear facilities, hospitals and industries, such as sources of Ra-226, Co-60, Ir-192 and Cs-137, is presented. The MAPA and MAPAM computer codes, based on point Kernel theory for calculating doses of several source-shielding type configurations, aiming to assure the safe transport conditions for these sources, was developed. The validation of the code for point sources, using the values provided by NCRP, for the thickness of lead and concrete shieldings, limiting the dose at 100 Mrem/hr for several distances from the source to the detector, was carried out. The validation for non point sources was carried out, measuring experimentally radiation dose from packages developed by Brazilian CNEN/S.P. for removing the sources. (M.C.K.).

7447 **(INIS-mf—11861) Studies on the long-term characteristics of HLW glass under ultimate storage conditions. Interim report for the period May 1, 1986 to January 31, 1987.** Roggendorf, H.; Conradt, R.; Ostertag, R. (Fraunhofer-Institut fuer Silicatforschung (ISC), Wuerzburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 31 Mar 1987. 23p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756185/JAW.

This interim report deals with first results of corrosion investigations of HLW simulation glass (COGEMA glass SON 68) in quinary salt solutions of different concentrations; the aim of these investigations was to find out about the corrosion mechanism at the surface of the glass and the quantitative registration of the corrosion products. It became obvious that the surface layers developed can be easily removed and that a determination of weight losses becomes possible thereby. The corrosion rates for a test period of 30 days were determined.

7448 **(K/ITP—232) International Atomic Energy Agency's advisory group meeting on safeguards related to the final disposal of waste and spent fuel, Vienna, Austria, September 12-16, 1988: Foreign trip report.** Moran, B.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1988. Contract AC05-84OT21400. 150p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004051/JAW.

B.W. Moran traveled to Vienna, Austria, during the period of September 12--16, 1988, to serve as the technical advisor to the US Department of Energy's (DOE's) Office of Civilian Radioactive Waste Management (OCRWM) representatives to the International Atomic Energy Agency's Advisory Group Meeting on "Safeguards Related to the Final Disposal of Nuclear Material in Waste and Spent Fuel." The goal of the US representatives to this meeting was to ensure that the advisory group's recommendations established (1) an effective IAEA safeguards approach for all radioactive waste and spent fuel management facilities and (2) a safeguards approach that is appropriate for the US Federal Waste Management System. The principal concerns of the United States on entering the advisory group meeting were: criteria for the termination of safeguards on waste should not be established, but should be referred for further study, safeguards on spent fuel should not be terminated, and safeguards studies are required before IAEA safeguards approaches for spent fuel are established. The US representatives generally recommended that consultant meetings be convened to address the technical issues after the requisite safeguards related research and development tasks have been performed. These objectives of the US representatives were achieved, and the recommendations of the advisory group generally coincided with and extended the recommendations presented in the US position paper.

7449 **(K/QT—203) Blast furnace slag-cement grout blends for the immobilization of technetium-containing wastes.** Bostick, W.D.; Shoemaker, J.L.; Fellows, R.L.; Spence, R.D.; Gilliam, T.M.; McDaniel, E.W.; Evans-Brown, B.S. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Nov 1988. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004102/JAW.

Mixed low-level radioactive and chemically toxic process treatment wastes from the Portsmouth Gaseous Diffusion Plant are stabilized by solidification in cement-based grouts. Conventional portland cement and fly ash grouts are shown to be very effective for retention of hydrolyzable heavy metals (including lead, cadmium, uranium, and nickel), but are marginally acceptable for retention of radioactive $^{99}$Tc (which is present in the waste as the highly mobile pertechnate anion). Addition of ground blast furnace slag to the grout is shown to reduce the effective diffusivity of technetium by several orders of magnitude; retention of technetium is improved by decreasing the waste loading in the grout or by increasing the proportion of blast furnace slag in the grout dry mix. The selective effect of slag is believed to be due to its ability to reduce Tc(VIII) to the less soluble Tc(IV) species. The addition of other reductive grout admixtures (e.g., sodium sulfide, ferrous ion, and powdered iron metal) also appear to improve the retention of technetium in grout. 31 refs., 2 figs., 25 tabs.

7450 **(KFK—4054) Radiochemistry Institute of Karlsruhe Nuclear Research Centre. Progress report on R and D work in 1985.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Feb 1986. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755966/JAW.

The Radiochemistry Institute carried out R and D work within the framework of the following projects: Project PWA, Reprocessing and Waste Treatment; project PSB, Fast Breeder Reactor; project PKF, Nuclear Fusion. Basic and applied problems in the field of surface chemistry and surface analysis were studied under the working programme 'Solids and Materials Research', and 'Technology - Man - Environment' was a point of main interest that gathered a number of working programmes in the field of water chemistry.

7451 **(LA—11443-PR) Research and development related to the Nevada Nuclear Waste Storage Investigations: Progress report, October 1--December 31, 1984.** Thomas, K.W. (comp.). (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 93p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004539/JAW.

This report summarizes some of the technical contributions by the Los Alamos National Laboratory to the Nevada Nuclear Waste Storage Investigations (NNWSI) Project from October 1

through December 31, 1984. The report is not a detailed technical document but does indicate the status of the investigations being performed at Los Alamos.

7452 **(ORNL/TM—10739) A preliminary assessment of the relationship between the mineralogy and diagenetic history of four argillaceous rocks and their thermomechanical properties.** Kopp, O.C.; Mulligan, P.J.; Reeves, D.K. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004250/JAW.

A primary purpose of this study was to develop reproducible, quantitative methods to determine the bulk mineral composition and diagenetic history of argillaceous rocks and to attempt, in a preliminary way, to explain the thermomechanical behavior of several formations that were being measured by others. This report presents the results of several methods of analysis [specific-gravity determinations, water contents, chemical analyses by x-ray fluorescence (XRF) analysis, quantitative mineralogical analyses by x-ray diffraction (QXRD), preferred orientation analyses by x-ray diffraction, and scanning electron microscopy (SEM) of fractured samples] that were used to study selected samples from the Conasauga Group, the Rhinestreet Shale, the Pierre Shale, and the Green River Formation to determine their mineralogical character and the effects of diagenesis on these materials. The results were then related to thermochemical test data that were obtained on samples from the same cores. Specific-gravity determinations on "as-received" samples ranged from 2.00 for the Green River Formation to 2.75 for the Rhinestreet Shale. Exposure to the atmosphere resulted in a small net gain (+0.5) in specific gravity for the Conasauga Group samples and a net loss (-0.11) for the Pierre Shale samples. Water contents, determined by heating to 105{degree}C for 1 h, averaged 0.8% by weight for the Conasauga Shale, Rhinestreet Shale, and Green River Formation samples. The water content determined for the Pierre Shale samples was 12.1 wt %.

7453 **(ORNL/TM—10835) GRESS [Gradient Enhanced Software System] Version 0.0 user's manual.** Horwedel, J.E.; Worley, B.A.; Oblow, E.M.; Pin, F.G.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004308/JAW.

The primary objective of this manual is to provide a description of the Gradient Enhanced Software System (GRESS) and to explain how to use GRESS to enhance FORTRAN 77 models for gradient calculation. The use of the Extended Arithmetic Processor (EXAP) as the precompiler for GRESS is presented. A complete description of how to enhance a source code for forward propagation of derivatives using the calculus chain rule is provided. On option, EXAP can be used to generate derivatives and store them on a direct access device for subsequent solution of the numerical adjoint equations. Programming information is also provided to aid in the installation and maintenance of the software.

7454 **(ORNL/TM—10939/V1) Data package for the Low-Level Waste Disposal Development and Demonstration Program environmental impact statement: Volume 1, Sections 1--7 and Appendices A--D.** Ketelle, R.H. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 468p. NTIS, PC A20/MF A01 - OSTI. Order Number DE89004299/JAW.

This data package is required to support an Environmental Impact Statement (EIS) to be written to evaluate the effects of future disposal of low-level waste at four sites on the Oak Ridge Reservation. Current waste disposal facilities are exceeding their capacities and increasingly stringent disposal requirements dictate the need for the sites and new waste disposal technologies. The Low-Level Waste Disposal Development and Demonstration Program has developed a strategy for low-level waste disposal built around a dose based approach. This approach emphasizes contamination pathways, including surface and groundwater and ALARA conditions for workers. This strategy dictates the types of data needed for this data package. The data package provides information on geology, soils, groundwater, surface water, and ecological characterization of the Oak Ridge Reservation in order to evaluate alternative technologies and alternative sites. The results of the investigations and data collections indicate that different technologies will probably have to be used at different sites. This conclusion, however, depends on the findings of the Environmental Impact Statement. 14 figs., 19 tabs.

7455 **(ORNL/TM—10939/V2) Data package for the Low-Level Waste Disposal Development and Demonstration Program environmental impact statement: Volume 2, Appendices E-O.** Ketelle, R.H. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 687p. NTIS, PC A99/MF A01 - OSTI. Order Number DE89004300/JAW.

This volume contains 11 appendices to the main document in Volume 1. Topics in Volume 2 include hydrologic data for a proposed solid waste storage area, soil characterizations, well logs, surface water discharge data, water quality data, atmospheric precipitation and stream flow, a small mammal survey, and general ecological information. (TEM)

7456 **(PB—88-247168/XAB) Radioactive waste management: policy making.** Metlay, D. (Office of Technology Assessment (U.S. Congress), Washington, DC). Jun 1981. 129p. NTIS, PC A07/MF A01.

Contents include: the policy-making process; defining radioactive wastes; storing radioactive wastes; utilizing the knowledge of the earth sciences in developing a waste-management program; developing a search strategy for sites; developing a waste package; determining acceptable safety levels for a geologic repository; the relationship between the federal government and the states in nuclear-waste management, and linking reactor operation with the development of techniques for radioactive-waste disposal.

7457 **(PB—88-249792/XAB) Sediment-monitoring parameters and rationale for characterizing deep-ocean low-level radioactive-waste-disposal sites.** Neiheisel, J. (Office of Radiation Programs, Washington, DC (USA)). Jun 1988. 31p. (EPA—520/1-87/011). NTIS, PC A03/MF A01.

The purpose of this report is to provide a rationale for the sediment measurements that will indicate radionuclide-retention characteristics at potential LLW disposal sites in the deep-ocean environment. Prior to sediment sampling, the site selection shall have been directed to specific areas by site-selection criteria supported by geophysical data to indicate site stability. Sediment sampling is conducted to meet the sediment monitoring and criteria needs for site characterization.

7458 **(PB—89-105118/XAB) Development of liquid-fed ceramic melter (LFCM) for commercial-scale vitrification.** Sakai, A.; Asano, H.; Murakoshi, T.; Saiga, H. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1988. 8p. NTIS, PC E03/MF A01.

Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 21, No. 3, 81-87(Jul 1988).

This paper describes the experimental results and evaluation of LFCM for commercial-scale vitrification. It is expected that some precipitates of noble metals are generated in the melting cavity, during the commercial vitrification in the high-burnup fuel reprocessing. LCFM should be designed so that it has a sloped floor with bottom sump which provides the opportunity for removing precipitated metal by a bottom drain.

7459 **(PNL—6656) PROBCON-HDW: A probability and consequence system of codes for long-term analysis of Hanford defense wastes.** Piepho, M.G.; Nguyen, T.H. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 161p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004506/JAW.

The PROBCON-HDW (PROBability and CONsequence analysis for Hanford defense waste) computer code system calculates the long-term cumulative releases of radionuclides from the Hanford defense wastes (HDW) to the accessible environment and compares the releases to environmental release limits as defined in 40 CFR 191. PROBCON-HDW takes into account the variability of input parameter values used in models to calculate HDW release and transport in the vadose zone to the accessible environment

(taken here as groundwater). A human intrusion scenario, which consists of drilling boreholes into the waste beneath the waste sites and bringing waste to the surface, is also included in PROBCON-HDW. PROBCON-HDW also includes the capability to combine the cumulative releases according to various long-term (10,000 year) scenarios into a composite risk curve or complementary cumulative distribution function (CCDF). The system structure of the PROBCON-HDW codes, the mathematical models in PROBCON-HDW, the input files, the input formats, the command files, and the graphical output results of several HDW release scenarios are described in the report. 3 refs., 7 figs., 9 tabs.

7460 **(PNL—6677) Soil erosion rates from mixed soil and gravel surfaces in a wind tunnel: A preliminary report.** Ligotke, M.W. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 62p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004857/JAW.

Tests of wind erosion were performed in a controlled-environment wind tunnel to support the development of natural-material protective barriers for long-term isolation of radioactive waste. Barrier performance standards currently being developed for internal and external barrier performance are expected to mandate a surface layer that is resistant to wind erosion. The purpose of this study was to initiate a series of tests to determine suitable soil and gravel mixtures for such a barrier and to test worst-case surface layer conditions under the influence of high wind speeds. Six mixed soil and gravel surfaces were prepared, weathered to represent natural wind-blown desert areas, and subjected to controlled wind erosion forces in a wind tunnel. The applied erosive forces, including surface shear forces, were characterized to provide a means of relating wind tunnel results with actual field conditions. Soil particle losses from the surfaces caused by suspension, saltation, and surface creep were monitored by aerosol sample probes and mass balance measurements. 23 refs., 22 figs., 3 tabs.

7461 **(PNL—6698) A comparison of the performance of nuclear waste glasses by modeling.** Grambow, B.; Strachan, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004739/JAW.

Through a combination of data collection and computer modeling, the dissolution mechanism of nuclear waste glasses has been investigated and more clearly defined. Glass dissolution can be described as a dissolution/precipitation process in which glass dissolves in aqueous solution and solids precipitate as the solubility products are exceeded. The dissolution process is controlled by activity of the rate-limiting specie $H_4SiO_4$. As a concentration of $H_4SiO_4$ increases, the rate of dissolution decreases until a final reaction rate is reached. Between the forward reaction rate (early time) and final reaction rate (very long time), glasses may exhibit an intermediate root time dependence caused by a transport resistance for the diffusion of $H_4SiO_4$ within the gel layer on the glass surface. In this report, three glasses are studied: JSS-A, PNL 76-68, and SRL-131. Data from static and dynamic leach tests are assembled, plotted, and successfully modeled. The kinetic parameters for these glasses are reported. With four parameters derived from experiments for each glass, the model can be used to calculate the effects of changes in the initial composition of the water contacting the glass. The effects of convective flow can also be modeled. Furthermore, glasses of different compositions can be readily compared. 49 refs., 27 figs., 5 tabs.

7462 **(PNL—6769) Leaching of $^{14}C$ and $^{36}Cl$ from Hanford reactor graphite.** Gray, W.J.; Morgan, W.C. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 93p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004979/JAW.

The leach rates of /sup 14C/ and /sup 36Cl/ were measured on solid cylindrical samples of graphite prepared from a bar retrieved from one of the surplus Hanford production reactors. Static leach tests were conducted in deionized water and Hanford ground water at temperatures of 20{degree}C to 90{degree}C for 8 weeks. The graphite samples were completely submerged in the leachant, and the entire volume of leachant was changed and analyzed weekly. The leach rates of both /sup 14C/ and /sup 36Cl/ decreased with time and appeared to approach steady-state values that were independent of temperature in the case of /sup 36Cl/ but decreased with temperature in the case of /sup 14C/. Both radionuclides leached more slowly in Hanford ground water. The data are compared with previously measured and estimated leach rates. Implications of the data regarding possible rate-limiting mechanisms are also discussed. 4 refs., 18 figs., 4 tabs.

7463 **(PNL-SA—15538) Gas-water-rock interactions during isothermal boiling in partially saturated tuff at 100{degree}C and 0.1 MPa.** Arthur, R.C.; Murphy, W.M. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 34p. (CONF-8807129—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003137/JAW.

From 1. international symposium on the thermodynamics of natural processes; Strasbourg, France (25 Jul 1988).

Mass-transfer calculations using the Rayleigh distillation equation and EQ3/6 show that porewaters in the candidate high-level nuclear waste repository at Yucca Mountain, Nevada, will be strongly affected by open-system boiling at 100{degree}C and 0.1 MPa. Variations in pH range from +1 to +4 units, and are caused by volatile weak electrolyte interactions as $Co_2(g)$ exsolves from the aqueous phase. Protolysis of $H_4SiO_4$ and mineral-solution reactions can moderate the increase in pH initially, but are not effective when boiling vaporizes more than approximately 0.2 wt % of the water. The host rocks will be affected by boiling because differences in the chemical potentials of components in the aqueous phase and minerals are created by the increases in pH. Experiments using carbonated solutions in closed systems are inappropriate for simulating water-rock interactions in this repository at temperatures greater than 100{degree}C. 25 refs., 6 figs., 2 tabs.

7464 **(SAND—88-7014) WIPP Hydrology Program Waste Isolation Pilot Plant, Southeastern New Mexico hydrologic data report No. 7: Parts A, WIPP-30, WIPP-12, and P-18 slug tests; B, H-11b4 drill-stem, slug, and pumping tests; C, H-18 pumping test; D, water-level data.** Stensrud, W.A.; Bame, M.A.; Lantz, K.D.; Palmer, J.B.; Saulnier, G.J. Jr. (Sandia National Labs., Albuquerque, NM (USA); Intera Technologies, Inc., Austin, TX (USA)). Nov 1988. Contract AC04-76DP00789. 430p. NTIS, PC A19/MF A01 - OSTI. Order Number DE89004642/JAW.

Part A of Hydrologic Data Report No. 7 contains the results of slug testing at WIPP-30, WIPP-12, and P-18. Part B describes the objectives, design, equipment, methodology, and results of the drill-stem and slug-test sequence, and a 72-hour pumping test, at a recently-drilled well at the H-11 hydropad, H-11b4. Part C discusses the equipment, pretest activities, testing, and the test results of a 72-hour pumping test conducted before pumping for water-quality sampling at well H-18. Part D presents plots and tabulations of water-level data collected from November 1, 1987 to April 30, 1988. The depths to water were measured in observation wells completed in the Dewey Lake Red Beds; the Forty-niner, Magenta Dolomite, and Culebra Dolomite Members of the Rustler Formation; the contact between the Rustler and Salado Formations; and the Bell Canyon Formation at and near the WIPP site. Part D also includes fluid-pressure data from the five-packer, long-term observation tool installed in H-16, which monitors fluid pressures in the five members of the Rustler Formation. Tabulations of the water-level and fluid-pressure data are presented in the appendixes to Part D. 7 refs., 115 figs., 166 tabs.

7465 **(SKB-PLAN—87) Costs of nuclear power radioactive waste products.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jun 1987. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755682/JAW.

The utilities are responsible for necessary measures of safety handling and final disposal of spent nuclear fuel and radioactive waste products from Swedish nuclear reactors. The main steps are planning, construction, and running of the vital plant systems. The utilities have commissioned SKB - Swedish fuel and waste management Co - for this task. In the report cost estimates of all these measures are presented. They are based upon a plan for handling and final disposal of the radioactive waste products, prepared by

SKB and described in the report. As final disposal of the highly active (long lived) waste products will not be started until some years after 2000, the continued research and development might indicate new processes, influencing system formulation as well as costs. This fact is considered result in simplified solutions. The plants and systems in operation or in construction are: * Transportation systems for radioactive waste products, * Central intermediate storage of spent fuel, CLAB, * Final storage of reactor waste products, SFR 1. In a later step are planned: * Processing plant for spent nuclear fuel, * Final storage of long life waste products, * Final storage of demolition waste products. The cost estimations include costs for research and development and for liquidation and demolition of the plants etc. The total future costs for the Swedish waste system from 1988 and on are estimated to SEK 39.5x10/sup 9/ in price level January 1987. The costs will fall due for 60 years. Per December 1987, SEK 6.1x10/sup 9/ in current price level were spent. (O.S.).

7466 **(SKI—87025) Demand and availability of chemical data for 'Project 90'.** Andersson, K. (Studsvik Energiteknik AB, Nykoeping (Sweden)). (Swedish Nuclear Power Inspectorate, Stockholm; Studsvik Energiteknik AB, Nykoeping (Sweden)). 30 Apr 1987. 18p. (STUDSVIK-NP—87-51). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755685/JAW.

The safety analysis performed within 'Project 90' includes transport modeling for the near zone and geosphere by a probabilistic model as well as by the NAMSOL model. In a later stage a detailed geochemical modeling may also be performed within the project. For all these models, data are required. In this report the need for and availability of data of chemical nature is reviewed. For a non site-specific, probabilistic model, the necessary chemical data seem to be available. The main problem is to choose appropriate distributions of distribution coefficients (K/sub d/-values). For a site-specific modeling the choice of site will determine the data available. A large amount of data for the sites studied by SKB are available. However site specific data on the complex forming agents in groundwater are unavailable for some sites. Data for groundwater constituents and fission and activation products are available for a detailed geochemical model, except for complex forming constants for humic material in the groundwater. Thermodynamic data for actinides are available, although the amount and quality vary. For some engineering materials (cement, bentonite) available data do not allow a detailed geochemical modeling. The solubilities of the rock and minerals present are not as well known, although data do exist. If kinetic effects are to be considered the data are poorly known. The influence of colloid formation of the actinides has to be considered in some way in connection with the modeling. There is not enough data available on this topic.

7467 **(UCID—21571) Preliminary scoping calculations of hydrothermal flow in variably saturated, fractured, welded tuff during the engineered barrier design test at the Yucca Mountain Exploratory Shaft Test Site.** Buscheck, T.A.; Nitao, J.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004982/JAW.

We model a hydrothermal system as a discrete fracture/matrix system, using the integral finite difference code TOUGH and the best available data on the fracture and matrix properties of Topopah Spring densely welded tuff. These calculations will also be useful for the design of the underground facilities in the vicinity of the EBDT; e.g., in determining the volume of undisturbed rock required for each EBDT heater. After conceptualizing our model to be an infinitely long heater (either horizontal or vertical) which is orthogonally intersected by an infinite set of uniformly spaced fractures, we justify its applicability to both horizontal and vertical heater emplacement. The calculations show that by the end of the full-power heating stage (t = 6 months), boiling in the rock results in complete desaturation out to a radius of r = 0.8 m from the heater axis, with partial desaturation occurring out to r = 1.8 m. Water vapor which does not leave the system via the borehole (to the drift) moves radially outward to the condensation zone lying 1.8–4.0 m from the heater axis. Gas pressures build up considerably within the matrix due to the low matrix permeability, but remain close to ambient within the fracture due to the high fracture permeability. At the end of the cooling stage (t = 24 months), the saturation in the matrix is below ambient for r < 3.0 m. Maximum temperature changes (above ambient) are 252.6{degree}C at the borehole wall, and 10.2{degree}C at a radial distance of 10.0 m from the heater axis. 32 refs., 17 figs., 2 tabs.←

7468 **(UCRL—21137) Standard review plan for reviewing safety analysis reports for dry metallic spent fuel storage casks.** (Lawrence Livermore National Lab., CA (USA); Nuclear Safety Engineering, Sacramento, CA (USA)). [1988]. Contract W-7405-ENG-48. 134p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004708/JAW.

The Cask Standard Review Plan (CSRP) has been prepared as guidance to be used in the review of Cask Safety Analysis Reports (CSARs) for storage packages. The principal purpose of the CSRP is to assure the quality and uniformity of storage cask reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. The CSRP also sets forth solutions and approaches determined to be acceptable in the past by the NRC staff in dealing with a specific safety issue or safety-related design area. These solutions and approaches are presented in this form so that reviewers can take consistent and well-understood positions as the same safety issues arise in future cases. An applicant submitting a CSAR does not have to follow the solutions or approaches presented in the CSRP. However, applicants should recognize that the NRC staff has spent substantial time and effort in reviewing and developing their positions for the issues. A corresponding amount of time and effort will probably be required to review and accept new or different solutions and approaches.

7469 **(UCRL—98756) Localized corrosion and stress corrosion cracking of candidate materials for high-level radioactive waste disposal containers in the US: A literature review.** Farmer, J.C.; McCright, R.D. (Lawrence Livermore National Lab., CA (USA)). 4 Nov 1988. Contract W-7405-ENG-48. 13p. (CONF-8810238—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002898/JAW.

From Materials Research Society meeting; Berlin, F.R. Germany (10 Oct 1988).

Container materials may undergo any of several modes of degradation in this environment, including: undesirable phase transformations due to lack of phase stability; atmospheric oxidation; general aqueous corrosion; pitting; crevice corrosion; intergranular stress corrosion cracking (IGSCC); and transgranular stress corrosion cracking (TGSCC). This paper is an analysis of data from the literature relevant to the pitting, crevice corrosion, and stress corrosion cracking (SCC) of these alloys. Though all three austenitic candidates have demonstrated pitting and crevice corrosion in chloride-containing environments, Alloy 825 has the greatest resistance to these forms of localized attack. Both types 304L and 316L stainless steels are susceptible to SCC in acidic chloride media. In contrast, SCC has not been documented for Alloy 825 under comparable conditions. Gamma irradiation has been found to enhance SCC of Types 304 and 304L stainless steels, but it has no detectable effect on the resistance of Alloy 825 to SCC. Furthermore, while microbiologically induced corrosion effects have been observed for 300-series stainless steels, nickel-based alloys such as Alloy 825 seem to be immune to such problems. Of the copper-based alloys, CDA 715 has the best overall resistance to localized attack. Its resistance to pitting is comparable to that of CDA 613 and superior to that of CDA 102. Observed rates of dealloying in CDA 715 are less than those observed in CDA 613 by orders of magnitude. The resistance of CDA 715 to SCC in tarnishing ammonical environments is comparable to that of CDA 102 and superior to that of CDA 613. Its resistance to SCC in nontarnishing ammonical environments is comparable to that of CDA 613 and superior to that of CDA 102. 22 refs., 8 figs., 4 tabs.

7470 **(UCRL—99734) Uranium transport in Topopah Spring tuff: An ion-microscope investigation.** McKeegan, K.D.; Phinney, D.; Oversby, V.M.; Buchholtz-ten Brink, M.; Smith, D.K. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-881066—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004778/JAW.

From 12. international symposium on the scientific basis for nuclear waste management; Berlin, F.R. Germany (10 Oct 1988).

We investigated the effect of different methods of surface preparation on ion-microscope profiles of uranium concentration (added to the sample by diffusion from an aqueous solution) vs depth in a welded, devitrified, tuffaceous rock from Yucca Mountain. The concentration profiles were used to study transport of uranium in the tuff. Four wafers of rock were prepared from primary drill core material and finished by polishing with increasingly finer abrasive material. Final polishes were made with 400 grit SiC, 600 grit SiC, 0.3 um alumina, and 0.05 um alumina. The polished tuff wafers were exposed for eight hours to a solution of groundwater doped with 2 ppM 235-U. The wafers were then examined by SEM and the ion microscope was used to measure the lateral and depth distributions of 235-U and other isotopes in the wafer. No systematic correlation of the measured 235-U concentration- vs-depth profiles with the degree of surface finish was observed, indicating that the polishing does not affect the measurable transport of U in the tuff. A zone of enhanced 235-U concentration was observed in the upper few microns, which we attribute to sorption onto surfaces of exposed pores. Concentrations of 235-U were elevated above background to depths >15 um, indicating that rapid transport paths exist. When the uranium distribution near the surface of the wafer was modelled by an error function, an upper limit for a slower transport path was defined by an apparent diffusion coefficient of approximately 10/sup {minus}13/ cm²/s. 5 refs., 5 figs., 1 tab.

7471 **(USGS-BULL—1777) Distribution, characterization, and genesis of mordenite in Miocene silicic tufts at Yucca Mountain, Nye County, Nevada.** Sheppard, R.A.; Gude, A.J. III; Fitzpatrick, J.J. (Geological Survey, Denver, CO (USA)). [1988]. Contract AI08-78ET44802. 22p. NTIS, PC A03/MF A01 - OSTI - US Geological Survey, Federal Center, Box 25425, Denver, CO 80225. Order Number TI89003673/JAW.

Tuffs at Yucca Mountain in the southwestern Nevada volcanic field are being investigated as a possible deep repository for high-level radioactive wastes. A sequence, as much as about 3000 meters thick, of Miocene silicic ash-flow tuffs, bedded tuffs, lavas, and flow breccias was derived chiefly from the Timber Mountain-Oasis Valley caldera complex. Previous studies by others of core from several drill holes have shown that much of the original vitric material of the volcanic and volcaniclastic rocks was altered during diagenesis to clay minerals, silica minerals, zeolites, and feldspars. Unaltered glass still persists in the upper part of the sequence, but zones characterized by clinoptilolite and mordenite, analcime, and albite follow in succession with depth. 28 refs., 16 figs., 5 tabs.

7472 **(VTT-SYMP—87) Third Finnish-German seminar on nuclear waste management 1986.** Lamberg, L. (ed.). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1988. 282p. (CONF-8709383—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW.

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The scope of the seminar was to provide an interdisciplinary forum for exchange of information and experiences in the field of nuclear waste management. The highlights of the seminar focused on the following topics: overall reviews, waste products, nearfield phenomena, site investigations, performance assessment and decommissioning. All together 20 papers were presented. Reviews, status reports and experimental studies dealt with general research programs and current research and development activities including regulatory aspects. Extensive discussions provided and opportunity to identify issues and options for further research.

7473 (VTT-SYMP—87, pp 22-29) **General review of radioactive waste management activities in the Federal Republic of Germany.** Krause, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

A survey is given of the present nuclear program in the Federal Republic of Germany; it is followed by a review of waste treatment and waste conditioning in nuclear power plants, fuel fabrication plants, in the WAK reprocessing plant, and in nuclear research facilities. The management of wastes arising from the application of isotopes is explained briefly. The present status of the activities on waste disposal in the Asse salt mine and of the investigations performed at the Konrad iron mine and at the Gorleben salt formation are described. Finally, a survey is given of R and D-activities carried out in radioactive waste management.

7474 (VTT-SYMP—87, pp 18-21) **Overall review on waste management in Finland - Current regulatory activities.** Ruokola, E. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The Finnish Centre for Radiation and Nuclear Safety is a competent authority responsible for the surveillance of the safety of nuclear installations. Its regulatory duties include surveillance of waste management operations and facilities under construction as well as safety related appraisal of future waste management concepts. The current activities of the Centre in the waste management field are concentrated on formulation of criteria for reactor waste disposal, surveillance of the construction of an interim storage for spent fuel and evaluation of the technical concepts and the preliminary site selection process for spent fuel disposal.

7475 (VTT-SYMP—87, pp 30-36) **Research on nuclear waste management at the Technical Research Centre of Finland.** Muurinen, A. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The research on nuclear waste management at the Technical Research Centre of Finland (VTT) started approx. 10 years ago. The waste research at VTT is carried out in separate laboratories. The work at VTT is mainly concentrated on the final disposal of the wastes. The research on the spent fuel consists of about 60-70% and the research on low and medium level waste about 20-30% of the total work. The volume of other topics, e.g. decommissioning, is few percentages annually. In accordance with the overall national research policy, much emphasis is also laid on international cooperation. This proceeding reviews also the research activities of different laboratories of the VTT at the field of nuclear waste management.

7476 (VTT-SYMP—87, pp 12-17) **Overall review on waste management activities in Finland - Programme of power companies.** Ryhaenen, V. (Teollisuuden Voima Oy (Finland)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

According to the Finnish legislation the waste producers are responsible for all phases of nuclear waste management. The requirements laid down in the decision of the government are included in the operating licenses of power plants. The power companies have founded the Nuclear Waste Commission of Finnish Power Companies (YJT) to coordinate the research work. YJT submits annually to the Ministry of Trade and Industry for review a research programme of the next calendar year as well as a report of the previous year. The final storage of spent reactor fuel as well as storage of low and intermediate level waste are reviewed in this proceeding. Testing of possible final disposal sites are also reviewed.

7477 (VTT-SYMP—87, pp 49-76) **Survey of the radioactive wastes in the Federal Republic of Germany.** Brennecke, P. (Physikalish-Technische Bundesanstalt, Braunschweig (Germany, F.G.)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In the Federal Republic of Germany radioactive wastes originate from reprocessing of spent fuel elements, the operation of nuclear power plants, the collecting depots of the federal states, the nuclear research establishments, the nuclear fuel cycle industry, the decommissioning and dismantling of nuclear facilities and other waste producers. It is being considered to dispose of these wastes in the former Konrad iron ore mine or in the planned repository in the Gorleben salt dome. To provide the necessary data base for the planning work being conducted by the Physikalisch-Technische Bundesanstalt, an extensive characterization of these wastes has been performed. Using today's figures and assumptions on the further growth of nuclear facilities, future amounts of the waste package volume have been estimated. On the basis of a site-specific safety assessment comprising the operational and post-operational phase of the planned Konrad repository, preliminary waste acceptance requirements have been derived. Waste packages intended to be disposed of in this facility must meet these requirements.

7478 (VTT-SYMP—87, pp 37-48) **Review of low and intermediate level waste in Finland.** Tusa, E.H.; Haerkoenen, H.T. (Imatran Voima Oy, Helsinki (Finland); Teollisuuden Voima Oy (Finland)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In Finland two power companies produce nuclear energy. Imatran Voima Oy operates two 445 MWe PWR units in Loviisa and the Industrial Power Company Ltd. two 710 MWe BWR units in Olkiluoto. In 1978 these two companies established the Nuclear Waste Commission of Finnish Power Companies to plan and coordinate the R and D in the field of nuclear waste management. The conditioning of both dry and liquid low and intermediate level radioactive wastes as well as the final disposal of them and the safety of final disposal are discussed in this proceeding.

7479 (VTT-SYMP—87, pp 108-120) **Dissolution of unirradiated UO/sub 2/ fuel pellets in groundwater.** Ollila, K. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The dissolution of unirradiated UO/sub 2/ fuel pellets in two synthetic groundwaters has been investigated. The one is meant to simulate the natural undisturbed chemical conditions deep in granitic bedrock and the other is meant to simulate the effects of bentonite. The pH and redox conditions of the waters were varied. The experiments were carried out under air-saturated conditions, and under oxygen-free conditions in an anaerobic glove cabinet and in an autoclave system developed for the simulation of deep groundwater conditions. The measured uranium concentrations in the undisturbed, synthetic groundwater and bentonite water varied under oxidizing conditions between 1-4x10/sup -3/ and 1-2x10/sup -3/ g U/l, respectively, and under reducing conditions between 1.0x10/sup -6/-2.5x10/sup -5/ and 1.0x10/sup -5/-1.9x10/sup -4/ g U/l, respectively. The formation of the surface layer and precipitation of uranium were observed in the waters.

7480 (VTT-SYMP—87, pp 96-107) **Spent fuel characterization with respect to the German disposal concept.** Closs, K.D. (Karlsruhe Nuclear Research Center, Karlsruhe (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

Spent fuel is not a homogeneous product, therefore irradiated reactor fuel requires thorough characterization to provide useful information to interpret radionuclide release. This has been done with respect to the axial and radial distribution of fission products and actinides, the macroscopic and microscopic surface, the grain size etc.. Moreover, the activity release from spent fuel in different salt brines was investigated for time periods up to two years. On the basis of those results, a first attempt was made to model long term radionuclide release from spent fuel in a geologic repository environment.

7481 (VTT-SYMP—87, pp 77-95) **Static interaction of the simulated German HLW-Glass product GP 98/12 with granitic waters at elevated temperatures and pressures.** Aalto, H.; Pentinghaus, H. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorimateriaaliryhmae; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany,F.R.) Inst. fuer Nuklaere Entsorgungstechnik). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

This proceeding reviews the hydrolytic reactions between high level radioactive waste in repository and its natural waters, which may cause local release of radionuclides and their transport within the specific site. Testing methods and results have also been reviewed in this proceeding.

7482 (VTT-SYMP—87, pp 146-168) **Chemical conditions in a repository. Experimental and modelling studies.** Snellman, M. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The chemical conditions in a repository for nuclear waste in granitic bedrock are of major importance for the integrity of the barriers in the repository, especially for the corrosion of waste canisters and dissolution of radionuclides. The chemistry of the near-field, i.. the pH, Eh and potential complexing ions, also affects the solubility and chemical form of radionuclides and the transport in the repository and the bedrock. The purpose of this study was to establish the effect of the materials introduced into the repository, such as construction materials, buffer and backfill materials and waste canisters, upon the chemical conditions in a repository for low and intermediate level reactor waste and spent fuel in granitic bedrock. The approach was through experimental studies of near field components, e.g. the wasteform, backfill on groundwater chemistry and theoretical studies, including modelling, which aimed at studying the evolution of the chemistry over longer time scales.

7483 (VTT-SYMP—87, pp 169-177) **Geohydrology and hydraulic testing of the rock.** Ylinen, A. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Geotekniikan Lab.). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In 1984, pressure tests were made in the island of Hasthölmen, in the Southern Finland, which is the possible disposal site for the low level nuclear waste. The spreading of the pressure in the rock was tested by measuring the hydraulic head in other, nearby boreholes, in different heights. The aim of the tests was to obtain information about the rock's ability of conducting water. Earlier, other one- and two-packer tests had been made to get an overall picture of the area. Thus the water-leading zones were known at the time of testing. The tests were simulated by using a finite-element code ADINAT ('heat-equation'-analogy) with a two-dimensional mesh of 1600 degrees of freedom. Isothropic and orthothropic properties of homogeneous material, or the model containing a fracture zone, were varied. The aim of the simulation was to get the same pressure spreading that was measured during the tests. The better the correspondence between the simulation and the tests, the better the parametres for the flow were assumed to be. The comparisons between the simulations and the tests were made by plotting the time histories of the hydraulic head. In the following figures both the measured head response and the simulated one are shown at each test point.

7484 (VTT-SYMP—87, pp 178-183) **Sorption and diffusion of radionuclides in rock.** Pinnioja, S.; Kaemaeraeinen, E.-L.; Suksi, S.; Jaakkola, T. (Helsinki Univ. (Finland). Dept. of Radiochemistry). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The migration of radionuclides in bedrock was estimated with laboratory experiments. Radionuclides studied were those important for the nuclear waste e.g. Cs, Sr, Co, Ni, Am and I. Sorption and diffusion were studied by the batch method for crushed samples and by the autoradiographic method for thin sections, rock pieces, drill core cups and natural fracture surface samples. The sorption order of elements was following: Ka(Cs) > Ka(Am) > Ka(Ni) > Ka(Co) > Ka(Sr) > Ka(I). Ka-values for natural fracture surfaces were high due to the altered minerals with a high sorption capacity. The range of Da-values of strontium was 1.4x10/sup -13/ m/sup 2//s. The Da-values of cesium and cobalt for tonalite were 7x10/sup -15/ m/sup 2//s and 5x10/sup -16/ m/sup 2//s, respectively.

7485 (VTT-SYMP—87, pp 184-189) **Industrial power company ltd (TVO). Preliminary site selection done by TVO.** Aeikaes, T. (Teollisuuden Voima Oy (Finland)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The site for final disposal of nuclear wastes in Finland will be selected on the basis of preceding investigations. The objective of the investigations is to collect sufficient data for characterization of potential areas. During the years 1983-1985 the suitability of numerous bedrock block areas for field investigations was evaluated using geological criteria. Geologically identified areas were classified on the basis of different environmental factors. In the first stage (1983-1985) potential areas for field investigations were identified and characterized. Preliminary field investigations will be carried out during the years 1986-1992 on 5-10 areas. As a result of the studies 101 potential areas were selected for field investigations. Furthermore, a separate geological study was made on the Olkiluoto area, where the nuclear power plants of Industrial Power Company are sited.

7486 (VTT-SYMP—87, pp 190) **Geological site selection studies in Precambrian crystalline rocks in Finland.** Vuorela, P. (Geologinen Tutkimuslaitos, Espoo (Finland)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In general geological investigations made since 1977 the Finnish crystalline bedrock has been determined to be suitable for the final disposal of the spent nuclear fuel. Regional investigations have been mainly based on already existing geological studies. Special attention has been paid on the international geological Finland as the Baltic Shield is stiff and stable and situated far outside the zones of volcanic and seismic activity. The present day crustal movements in Finland are related to landuplift process. Movements and possible faults in the bedrock follow fracture zones which devide the bedrock into mosaiclike blocks. As compared to small scale geological maps the bedrock blocks are often indicated as large granite rock formations which are less broken than the surrounding rocks, though the age of granite formations is at least 1500 millions of years. The large bedrock blocks (20-300 km/sup 2/) are divided to smaller units by different magnitudes of fractures and these smaller bedrock units (5-20 km/sup 2/) have been selected for further site selection investigations. At the first stage of investigations 327 suitable regional bedrock blocks have been identified on the basis of Landsat-1 winter and summer mosaics of Finland. After two years of investigations 134 investigation areas were selected inside 61 bedrock blocks and classified to four priority classes, the three first of which were redommended for further investigations. Geological criteries used in classification indicated clear differences between the classes one and three, however all classified areas are situated in large rather homogenous bedrock blocks and more exact three dimensional suitability errors may not be observed until deep bore holes have been made.

7487 (VTT-SYMP—87, pp 191-208) **Structural mapping based on geophysical methods.** Saksa, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Geotekniikan Lab.). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In nuclear waste disposal site investigations geophysical measurements are used for detailed site characterization. Variations in rock types and fracturing cause anomalies in surveys. However, especially fracturing analysis calls for further processing of results. Examples of the integrated use of single-hole logs in fracture type analysis and of the combination of single-hole and crosshole measurements is presented from Lavia test site. Oncoming new methods are also briefly discussed in the paper.

7488 (VTT-SYMP—87, pp 209-227) **Safety analysis of disposal of low and intermediate level reactor waste.** Vieno, T. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The scenarios employed and the results obtained in the PSAR safety analyses of the repositories for low and intermediate level reactor waste are presented. The repositories are to be located at the Loviisa and Olkiluoto nuclear power plant sites and will consist of rock cavities excavated at the depth of about 50 to 125 m.

7489 (VTT-SYMP—87, pp 228-261) **German approach to the disposal of radioactive wastes.** Warnecke, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In the Federal Republic of Germany the Physikalisch-Technische-Bundesanstalt (PTB) is responsible for the construction and operation of the repositories in which radioactive wastes will be disposed of. Two repositories are planned: Gorleben (salt dome; for all types of radioactive wastes), Konrad (abandoned iron ore mine; for radioactive wastes with negligible thermal influence upon the host rock). The safe operation of the repositories has to be demonstrated to the licensing authorities. These are the responsible Ministers of the Federal States (Laender) and the mining authorities. According to the /sup s/afety criteria for the disposal of radioactive wastes in a mine/sup ,/ the safety of a repository has to be demonstrated by a site specific safety assessment for the normal operation of a repository, for incidents in the operational phase, and the post-operational phase. These assessments result in waste acceptance requirements. The compliance of the waste packages to be disposed of with the waste acceptance requirements is checked with a waste package quality control either by random tests on waste packages or a qualification and inspection of waste conditioning processes. Preliminary waste acceptance requirements have been set up for the planned Konrad repository. In the Kernforschungsanlage Juelich (KFA) a group for the quality control of radioactive waste has been established on behalf of the PTB. The application documents for Konrad have been completely submitted to the licensing authority. The operation of the Konrad repository is anticipated for the year 1990. Preliminary safety assessments have only been performed for the Gorleben site on the basis of model assumptions. These are planned to be updated in 1986/87 on the basis of the results of the site investigation from surface and on new data of the wastes to be disposed of.

7490 (WINCO—1060) **Modeling hypothetical groundwater transport of nitrates, chromium, and cadmium at the Idaho Chemical Processing Plant.** Thomas, T.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-84ID12435. 89p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004987/JAW.

One of the alternative strategies under evaluation for long-term management of the Idaho Chemical Processing Plant (ICPP) high-level radioactive waste (HLW) is on-site near-surface disposal of HLW calcine. About 18 Calcine Solids Storage Facilities (CSSF) would contain a maximum of 2.65 {times} $10^4$ $m^3$ of HLW calcine by the year 2034, if not other management strategy wee selected. The purpose of this study is to begin the documentation process which will be required for evaluation of the on-site near-surface option. The approach was to assimilate the available hydrogeological data for the ICPP area and employ a state-of-the-art code to model potential solute transport from the calcine into the aquifer. The results of this study are intended to provide guidance for future modeling studies and identify areas where more laboratory and field data are needed. For the study, a three-dimensional code called TRACR3D, which is applicable to solute transport in both unsaturated and saturated media was used. The hypothetical transport of three non-radioactive constituents ($CR^{+2}$, $Cd^{+2}$, and $NO_3$/ sup {minus}/) from the calcine in one CSSF, due to rainwater recharge, to and downgradient in the aquifer was modeled up to 10,000 years. 34 refs., 38 figs., 5 tabs.

7491 **Analysis of the radiative and conductive heat transfer characteristics of a waste package canister.** Vafai, K.; Ettefagh, J. (Department of Mechanical Engineering, Ohio State University, Columbus, OH 43210). *Journal of Heat Transfer;* **110**: No. 4, 1011-1014(Nov 1988).

The effects of stabilizers on the heat transfer properties and temperature distribution inside a radioactive waste canister are studied. The two-dimensional energy equations are solved numerically. (AIP)

7492 **Soret diffusion processes in aqueous sodium chloride solutions.** Cygan, R.T. (Sandia National Laboratories, Albuquerque, NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 557(1985). (CONF-8510489—). Contract AC04-76DP00789.

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

The mass transport of chemical species induced by a temperature gradient, commonly known as Soret diffusion, has been examined for the case of the sodium chloride and water system. The occurrence of significant thermal gradients in geological media, especially those associated with radioactive waste disposal sites, can produce a measurable flux of sodium chloride and therefore enrich the local solutions. Soret coefficients, or the ratio of thermal to isothermal mass transport factors, describe this rate of mass transfer and are necessary for evaluating certain nonequilibrium processes, such as the migration of fluid inclusions in rock salt. Experimental Soret coefficients for the NaCl-$H_2O$ system were obtained by the use of a conductimetric thermal diffusion cell. This approach relies on monitoring the electrical conductivity change of two separate isothermal reservoirs which are maintained at different temperatures. The Soret cell is situated between the reservoirs and is comprised of an inert matrix of glass beads in order to minimize any solution convection. The utilization of this porous medium requires corrections for porosity and tortuosity. Measurements were made for 0.1 and 1.0 N NaCl solutions at mean temperatures of 40°C and 50°C with the mass transport induced by a thermal gradient of 2.6°C/cm. The preliminary results indicate a Soret separation on the order of 1 to 2 percent with the attainment of a steady state in approximately 15 hours.

7493 **Deformation history of competent interbeds in layered evaporites, waste isolation pilot plant (WIPP), SE New Mexico.** Borns, D.J. (Sandia National Laboratories, Albuquerque, NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 528-529(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Evaporite sequence have been studied as hosts for radioactive wastes. In addition to halite, layered evaporites are characterized by anhydritic, dolomitic and argillitic interbeds. Such interbeds range in thickness from centrimeters to meters. Questions regarding such interbeds are: 1) are there structural events masked in halite but exhibited in the interbeds; 2) will the interbeds have structurally distinct behavior, relative to halite, during creep closure of a repository; 3) can fluid migrate in the interbeds? With the development of the WIPP site, an interbed was exposed in shafts and drillcore at 2200ft below ground level. Study of this interbed addresses the questions above. 1) Structural events: As exhibited in the anhydritic interbed, some structures formed during deposition and diagenesis. Depositional structures are evident in the reworking of the interbed during the transition back into halite deposition. Post-diagenetic fractures, now partially infilled by polyhalite and halite, formed in the interbed. Later-stage fluids have become concentrated in fractures of the interbed. Such fluids are pressurized but irregularly distributed. Such fluid concentrations, whether in the geologic past or in the present as a response to the mined environment, could result from the migration of in situ fluids down pressure gradients into a fracture system, as it propagated in the past and/or present.

## 0530 Environmental Aspects

*REFER ALSO TO CITATION(S) 7415, 7416, 7417, 7418, 7421, 7422, 7423, 7424, 7425, 7426, 7427, 7430, 7431, 7432, 7433, 7434, 7435, 7436, 7437, 7438, 7439, 7441, 7442, 7451, 7452, 7453, 7454, 7455, 7459, 7460, 7461, 7462, 7463, 7464, 7467, 7468, 7469, 7470, 7471, 7479, 7480, 7481, 7484, 7496, 9401*

7494 **Long-term phytoavailability of soil-applied organoborates.** Adriano, D.C.; Kaplan, D.I.; Burkman, W.G.; Mills, G.L. (Savannah River Ecological Lab., Aiken, SC (USA)). *Journal of Environmental Quality;* **17**: No. 3, 485-492(Jul-Sep 1988). Contract AC09-76SR00819.

Sodium tetraphenylboron (NaTPB) is expected to be used in large quantities to separate radiocesium from high-level nuclear wastes. Greenhouse experiments were conducted to determine the long-term effects of NaTPB, diphenylboric acid (DPBA, a major degradation by-product of NaTPB) and boric acid (BA) on the extractability of soil B and plant B nutrition. Sorgrass (Sorghum vulgare sudanense Hitchc. Dub-L-Graze) was planted in sandy and loamy sandy soils in two separate 2-yr studies. Results indicate that initial differences between effects of the B sources on biomass, plant B concentration, plant B uptake and hot-water extractable B disappeared after the first harvest, while differences among these parameters due to soil type and application rate remained throughout the experiments. Extractable soil and plant B concentrations tended to decrease more gradually in the loamy sand than in the sandy soil. Plant toxicity from organic sources was noted only during the first harvest while BA had no adverse effects. Both NaTPB and DPBA reduced biomass, the former more than the latter. Initially, plant B concentrations were higher in NaTPB than BA treatments. The cumulative percentage of soil-applied B removal after 2 yr by sorgrass remained fairly similar, 20.0 +/- 1.7% (1SD) among B sources and application rates. This suggests that a large fraction of B applied to the soil was not taken up by the plant, presumably due to soil fixation. Biphenyl, another major breakdown product of NaTPB, had no effect on sorgrass growth, tissue B concentration, and soil B concentration.

7495 **Assessment, communication, and management of environmental risks.** Ruckelshaus, W.D. (William D. Ruckelshaus Associates, Seattle, WA (USA)). pp 333-340 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The author discusses some of the broader issues relating to the application of biotechnology. The application of biotechnology to contaminated Superfund sites is presented. The important aspect of public participation is discussed in relation to decision making concerning environmental risk reduction. There is an element of responsibility involved in this participation. The public has to accept responsibility for the decisions it has made, an ultimate obligation of citizenship.

## 0540 Health And Safety

**7496 (DOE/HWP—60) A scoping study to evaluate the use of incineration to manage future Air Force Logistics Command hazardous wastes.** (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 292p. (ORNL/M—559). NTIS, PC A13/MF A01 - OSTI. Order Number DE89004243/JAW.

The Air Force Logistics Command (AFLC) implemented an aggressive waste minimization program called PACER REDUCE to achieve a 50% reduction in the hazardous waste disposal volume by 1992. When PACER REDUCE was implemented in late 1985, considerable attention was being placed on identifying long-term alternatives to landfill disposal. In late 1986, a program was begun to evaluate the feasibility of constructing Air Force incinerators for the treatment of hazardous waste generated by AFLC. The program had two major thrusts. First, the current and emerging incineration technologies would be reviewed, actual test burns would be conducted in up to three of the most viable technologies, and a report would be prepared to document findings and recommendations. Second, contracts would be let to evaluate the siting and economic factors influencing the construction of incinerators at the ALCs, to review the expected environmental effects of such construction, and to study the characteristics of waste generation within AFLC, both now and in the future. The first program objective was conducted by staff at 00-ALC and is called the Incineration Feasibility Study. This contract was awarded and is nearly complete and consists of six major tasks.

**7497 (EGG-WM—8303) Geophysical techniques for the Radioactive Waste Management Complex Subsurface Disposal Area.** Brown, R.M.; Quintana, B.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-76ID01570. 118p. (WM-PD—88-001). NTIS, PC A06/MF A01 - OSTI. Order Number DE89004872/JAW.

During the early years of the Idaho National Engineering Laboratory (INEL), 1954 through 1970, approximately two million cubic feet of transuranic (TRU) waste, principally consisting of plutonium-contaminated materials, was buried in the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC). This waste was later found to also contain various solvents such as carbon tetrachloride. Since 1970 the TRU waste received at the RWMC has been retrievably stored on above-grade asphalt pads at the Transuranic Storage Area (TSA) adjacent to the SDA. This report uses literature searches, discussions with experts, and trips to developmental facilities to compare various geophysical methods. The methods evaluated include resistivity, electromagnetic induction (EM), ground penetrating radar (GPR), seismic, magnetics, gravity, radioactivity, shallo-temperature surveys, muon/borehole tomography, thermal infrared, and geothermometry. The study determined that the most promising methods for satisfying the SDA/RWMC objectives are GPR, resistivity or EM, magnetics, and some form of borehole profiling. These techniques are described in Section 2.0. Brief descriptions of methods that were determined to be inadequate for SDA use are given in Appendix A. 32 refs., 9 figs., 3 tabs.

**7498 (INIS-mf—11325) Design of diagnostic medical facilities using ionizing radiation. A code of practice prepared by the Medical Radiation Advisory Committee of the Nuclear Energy Board.** (Nuclear Energy Board, Dublin (Ireland)). Mar 1988. 47p. NTIS (US Sales Only), PC A03/MF A01 - Nuclear Energy Board, 3 Clonskeagh Square, Dublin 14, Ireland. Order Number DE88704802/JAW.

This Code, setting out the general principles of radiological protection as applied to diagnostic radiation facilities in hospitals and clinics, is intended as a guide to architects and to works departments concerned with their design and construction, and with the modification of existing units.

**7499 (PNL-SA—15887) The remedial action priority system (RAPS): Comparison between simulated and observed environmental contaminant levels.** Whelan, G.; Strenge, D.L.; Droppo, J.G. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 39p. (CONF-881141—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004360/JAW.

From Superfund '88: 9th national conference and exhibition on hazardous waste; Washington, DC, USA (28 Nov 1988).

The Remedial Action Priority System (RAPS) is an objective, physics-based, fully integrated multimedia environmental assessment methodology. RAPS assesses environmental issues associated with hazardous and radioactive mixed-waste sites based on relative human health risk and limited site information. the purpose of this paper is to report on the results associated with applying components of the RAPS methodology to a variety of sites with different contaminant release mechanisms. These applications illustrate the type of data typically required to implement the methodology and several of the types of contaminant releases (e.g., direct discharge, French drain, cribs, tile field, and stacks) that can be considered by the methodology. They thus demonstrate the applicability of the methodology at a wide variety of sites. The various components of the RAPS methodology have been implemented at actual sites where contaminant levels have been monitored in the environment. The monitored contaminant levels are compared to simulated contaminant levels associated with the application to the RAPS methodology at these sites. The purpose of the comparison is to demonstrate the applicability of implementing RAPS to a wide variety of hazardous waste sites and releases of contaminants into the environment. 21 refs., 13 figs.

## 0550 Safeguards, Inspection, And Accountability

*REFER ALSO TO CITATION(S) 8636, 10584, 10595*

**7500 (BNL—41697) Technology transfer significance of the International Safeguards Project Office.** Marcuse, W.; Waligura, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1988. Contract AC02-76CH00016. 9p. (CONF-880631—57). NTIS, PC A02/MF A01 - OSTI. Order Number DE89001101/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The safeguards implemented by the International Atomic Energy Agency (IAEA) are of major importance to the non-proliferation objectives of the United States of America and other nations of the world. Assurance of safeguards effectiveness is mandatory to continued peaceful use of nuclear power. To enhance the ability of the IAEA to apply safeguards effectively, and to ensure that the IAEA does not lack technical assistance in critical areas, the US Congress has made available a special authorization for a Program for Technical Assistance to IAEA Safeguards (POTAS). This substantial program of technology transfer was initiated in 1976. The United States Departments of State and Energy, the Arms control and Disarmament Agency and the Nuclear Regulatory Commission have each accepted responsibility for parts of the Program for Technical Assistance to IAEA Safeguards. Funding is provided by state through the Foreign Assistance Act. This report provides a discussion of this program.

**7501 (K/ITP—156/P4/R1) Nuclear material safeguards for enrichments plants: Part 4, Gas Centrifuge Enrichment Plant: Diversion scenarios and IAEA safeguards activities: Safeguards training course.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1988. Contract AC05-84OT21400. 327p. (ISPO—284/P4/R1; CONF-881199—Pt.4-Vugraphs). NTIS, PC A12/MF A01 - OSTI. Order Number DE89002497/JAW.

From Safeguards training course: nuclear material safeguards for enrichment plants; Vienna, Austria (14 Nov 1988).

This publication is Part 4 of a safeguards training course in Nuclear Material Safeguards for enrichment plants. This part of the course deals with diversion scenarios and safeguards activities at gas centrifuge enrichment plants.

7502 **(LA—11356-PR) Safeguards and security: Progress report, January--December 1987.** Smith, D.B.; Jaramillo, G.R. (comps.). (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 125p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004545/JAW.

From January to December 1987, the Los Alamos Safeguards and Security Research and Development (R&D) program carried out the activities described in the first four parts of this report: Science and Technology Base Development, Basic Systems Design, Onsite Test and Evaluation, and International Safeguards. Part 1 covers development of the basic technology essential to continuing improvements in the practice of safeguards and security. It includes our computer security R&D and the activities of the DOE Center for Computer Security, which provides the basis for encouraging and disseminating this emerging technology. Part 2 treats activities aimed at the development of methods for designing and evaluating safeguards systems, with special emphasis on the integration of the several subsystems into a real safeguards system. Part 3 describes efforts of direct assistance to the DOE and includes consultation on materials accounting problems development and demonstration of specialized techniques and instruments, and comprehensive participation in the design and demonstration of advanced safeguards systems. Part 3 also reports a series of training courses in various aspects of safeguards that makes the technology more accessible to those who must apply it. Finally, Part 4 covers international safeguards activities, including both support to the International Atomic Energy Agency and bilateral exchanges. Part 5 reports several safeguards-related activities that have sponsors other than the DOE/OSS. The final part of this report list titles and abstracts of Los Alamos safeguards R&D reports, technical journal articles, and conference papers that were published in 1987. 68 refs., 29 figs., 17 tabs.

7503 **(NUREG—1328) Use of perimeter alarms at fuel fabrication facilities using or possessing formula quantities of strategic special nuclear material.** Dwyer, P.A.; Gaskin, C.E. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Dec 1988. 14p. NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89004555/JAW.

This guidance document presents information on installation, system objectives, maintenance, and testing of perimeter intrusion detection systems at fuel fabrication facilities using or possessing formula quantities of strategic special nuclear material.

7504 **(NUREG—1330) Personnel and vehicle barriers at fuel fabrication facilities using or possessing formula quantities of strategic special nuclear material.** Rentschler, R.R. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Dec 1988. 21p. NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89004556/JAW.

This document provides information on the use and availability of barriers designed to deny unauthorized personnel and vehicle entry to fuel fabrication facilities using or possessing formula quantities of strategic special nuclear material. 7 refs., 13 figs.

7505 **(SAND—88-1003) A laboratory-simulation approach to the evaluation of vision systems for teleoperated vehicles.** Miller, D.P.; McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 16p. (CONF-880752—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE88011707/JAW.

From International symposium on teleoperation and control; Bristol, UK (12 Jul 1988).

In order to perform teleoperated missions successfully, a remote vehicle operator must be provided with adequate feedback information. The limited bandwidth of the transmission media,however, forces trade-offs between channel quantity and fidelity. Since conveying vehicle motion cues to the driver in the field is impractical, the primary mode of feedback is visual, via and on-board closed-circuit television system. Intelligent allocation of video bandwidth is predicated on determining which video resolution, field-of-view, color, steering coupling, and the use of multiple cameras. Sandia National Laboratories is conducting mobility testing to study these effects on off-road, remote driving performance. Recent activities included conducting an experiment to investigate the relationships between remote driving performance and laboratory visual performance tasks using videotapes of off-road driving recorded with the vision systems of interest. Subjects participated either in actual remote driving (teleoperation) or in video simulation of remote driving using three different video systems currently being considered for prototype teleoperated vehicle. This paper discusses the results of the experiment. Analysis of the data suggests that the laboratory simulation technique is viable for comparing obstacle detection and identification performance while using different video systems. The establishment of a valid, inexpensive laboratory simulation technique is can lead to a cost-effective means of evaluating and comparing numerous combinations of video system parameters for use in teleoperated land vehicles. 7 refs., 5 figs.

## 0560 Legislation And Regulations

*REFER ALSO TO CITATION(S) 7397*

7506 **(INIS-XN—128) Ministerial Order concerning radioactive contamination of agricultural products.** (International Atomic Energy Agency, Vienna (Austria)). 6 Nov 1987. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704919/JAW.

Published in Moniteur belge.

The purpose of this Order is to implement at national level Articles 1 and 3 of the Council of the European Communities' Regulation No. 1707/86 of 30th May 1986, as amended by Commission Regulation No. 1762/86 of 5th June 1986 (Official Journal of the European Communities 1986 Nos. L 146 and L 152), on conditions for the import of agricultural products from non-European Community States after the Chernobyl accident.

7507 **(INIS-XN—133) Decree No. 88-521 of 18 April 1988 amending Decree No. 66-450 of 20 June 1966 on general protection principles against ionizing radiation.** (International Atomic Energy Agency, Vienna (Austria)). 6 May 1988. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704924/JAW.

Published in Journal Officiel de la Republique francaise.

This Decree amends, in particular, the technical provisions of the 1966 Decree to take into account the Directives of the Council of the European Communities (No. 80-836 and No. 84-467 modifying the latter) amending the Community basic radiation protection standards.

7508 **(INIS-XN—134) Order of 30 March 1988 on licensing of gaseous radioactive effluent releases by the Fontenay-aux-Roses Nuclear Research Centre.** (International Atomic Energy Agency, Vienna (Austria)). 8 May 1988. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704925/JAW.

Published in Journal Officiel de la Republique francaise.

This Decree prescribes the documents and information the Fontenay-aux-Roses Nuclear Research Centre must provide to the Central Service for Protection against Ionizing Radiation (SCPRI) and lays down the permissible effluent release limits for the Centre.

7509 **(INIS-XN—137) Order of 30 September 1987 confirming the Orders of 18 April 1968, 19 April 1968, 20 April 1968, 22 April 1968 and 23 April 1968 on protection of workers against the hazards of ionizing radiation.** (International Atomic Energy Agency, Vienna (Austria)). 9 Oct 1987. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704928/JAW.

Published in Journal Officiel de la Republique Francaise.

These Orders were confirmed in implementation of the Decree of 2 October 1986 which repealed and replaced the Decree of 15 March 1967 on protection of workers against radiation hazards. They respectively concern control methods established by the Central Service for Protection against Ionizing Radiation; conditions of use of personal dosimeters; regular controls of sealed sources, radiation-emitting apparatus and their protection devices;

conditions for approving agencies authorized to monitor workers; recommendations for physicians responsible for medical surveillance of workers.

**7510 (INIS-XN—138) Order of 31 July 1987 on protection and control of nuclear materials carried by air.** (International Atomic Energy Agency, Vienna (Austria)). 27 Aug 1987. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704929/JAW.

Published in Journal Officiel de la Republique Francaise.

This Order is part of a series of texts on protection and control of nuclear materials which include: the Act of 25 July 1980 and the Decree of 12 May 1981 made in its implementation and, as regards the specific aspect of protection and control of materials during transport, the Order of 26 March 1982 amended in 1986. The 1987 Order lays down the conditions which must be complied with by approved carriers (the French or the foreign holders of a licence under the above-mentioned Act of 1980) in case of transport of such materials by air.

**7511 (INIS-XN—140) Staatsblad 343 - Order of 4 June 1987 amending the Order concerning transport of fissile materials, ores and radioactive materials.** (International Atomic Energy Agency, Vienna (Austria)). 23 Aug 1987. 28p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704931/JAW.

Translated from Dutch.

This Decree amends the 1969 Decree to take account of developments in international transport regulations, already taken into account in the national regulations for all modes of transport of dangerous materials or goods. Further amendments concern physical protection requirements in compliance which the Convention on the Physical Protection of Nuclear Material which the Netherlands signed as a Member State of the European Communities. In essence, the modifications relate to licensing requirements in particular packaging and transport conditions for the different levels of activity of the materials carried, certificates of approval etc., and surveillance during transport. The Decree entered into force on 23 August 1987.

**7512 (SAAS-Mitt—87-05) Guideline on helding intraplant radiation protection training courses.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 14p. (In German). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705219/JAW.

The guideline which entered into force on 30 July 1987 regulates the acquisition of required knowledge in radiation protection by radiation workers and operators through intraplant radiation protection training courses and establishes recognized careers. Curricula examples for several nuclear fields are given in the appendix.

**7513 (SAAS-Mitt—87-06) Guidance for the licensing procedure concerning the application of radiographic equipment.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 16p. (In German). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705220/JAW.

According to article 4 of the Ordinance on the Implementation of Atomic Safety and Radiation Protection dated 11 October 1984 the operation of radiographic equipment has to be licensed. The personnel and material requirements that are to be fulfilled by a licensee prior to commissioning X-ray or gamma equipment, are discussed in detail.

# 07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

## 0701 Physical Isotope Separation

**7514 (CERN-EP—88-118) Production of short-lived isotopes at the ISOLDE on-line mass-separator.** Hagebo, E.; Hoff, P.; Jonsson, O.C.; Kugler, E.; Ravn, H.L.; Sundell, S.; Vosicki, B. (European Organization for Nuclear Research, Geneva (Switzerland)). 1988. 33p. (CONF-8807133—1). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89003204/JAW.

From 2. international conference on nuclear and radiochemistry; Brighton, UK (11 Jul 1988).

A survey of the target and ion-source techniques used at the ISOLDE isotope separators for production of short-lived mass-separated nuclei is given. The production of high intensity beams of radioactive nuclei by bombardment of thick targets with 600 MeV protons or 910 MeV $^3$He is discussed. The release properties of different refractory target materials is presented, as well as the influence of reactive gases and the development of ion sources. Results of on-line tests are given. 23 refs., 16 figs.

**7515 (INFO—0102-4) Probabilistic consequence assessment of hydrogen sulphide releases from a heavy water plant. Sensitivity study of sulphur dioxide toxicity.** Baynes, C.J. (Monserco Ltd., Mississauga, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1985. 20p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705103/JAW.

This study investigates the sensitivity of the probabilistic consequences projected by the computer code GASPROB to changes in the assumed toxicity of sulphur dioxide gas (SO/sub 2/). GASPROB simulates the consequences of accidental releases to the atmosphere of hydrogen sulphide (H/sub 2/S) at a heavy water plant. Five combinations of different LC50 and LC10 functions (lethal concentration versus exposure time) were tested, each varying over 3 orders of magnitude. The results indicate a distinct sensitivity to both the LC50 and LC10 functions.

## 0702 Radiation Sources

*REFER ALSO TO CITATION(S) 9172*

**7516 (CONF-880546—43) 2.5 MeV neutron source for fission cross section measurement.** Duvall,, K.C.; Wasson, O.A.; Ma, Honchang. (National Bureau of Standards, Washington, DC (USA)). 1988. Contract AI01-86ER40275. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004816/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

A 2.5 MeV neutron source has been established on the beamline of a 100 kV, 0.5 ma ion accelerator. The ion accelerator provides a 100 kV deuteron beam of about 200 $\mu$a into a 3 mm beam spot at the target position. The neutron source is produced by the D(d,n)$^3$He reaction with a yield of about $10^7$ n/sec. The time-correlated associated particle method (TCAP) is utilized for the neutron fluence determination and for neutron background elimination. The $^3$He associated particles are detected at 90 degrees behind a thin aluminum foil and the corresponding neutrons are emitted at 73.5 degrees with an energy near 2.5 MeV. Also, the protons from the competing D(d,p)T reaction are monitored at 135 degrees for normalization and diagnostic purposes. A fission chamber containing six uranium tetrafluoride deposits has been designed for use in the $^{235}$U(n,f) cross section measurement at 2.5 MeV. The 5 cm diameter deposits range in thickness from 230--300 $\mu$g/cm$^2$ and are expected to have good uniformity. A description of the 2.5 MeV neutron source facility is presented along with details of the associated particle detection and neutron beam characteristics. Preparations for the fission cross section measurement are discussed. 6 refs., 4 figs.

7517 **(EUR—10968) Optimisation and symmetry in experimental radiation physics.** Ghose, A. (Commission of the European Communities, Ispra (IT). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1988. 163p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756244/JAW.

The present monograph is concerned with the optimisation of geometric factors in radiation physics experiments. The discussions are essentially confined to those systems in which optimisation is equivalent to symmetrical configurations of the measurement systems. They include, measurements of interaction cross section of diverse types, determination of polarisations, development of detectors with almost ideal characteristics, production of radiations with continuously variable energies and development of high efficiency spectrometers etc. The monograph is intended for use by experimental physicists investigating primary interactions of radiations with matter and associated technologies. We have illustrated the various optimisation procedures by considering the cases of the so-called "14 MeV" on d-t neutrons and gamma rays with energies less than 3 MeV. Developments in fusion technology are critically dependent on the availability accurate cross sections of nuclei for fast neutrons of energies at least as high as d-t neutrons. In this monograph we have discussed various techniques which can be used to improve the accuracy of such measurements and have also presented a method for generating almost monoenergetic neutrons in the 8 MeV to 13 MeV energy range which can be used to measure cross sections in this sparingly investigated region.

7518 **(JINR—13-88-60) Electron pulsed beam induced processing of thin film surface by Nb/sub 3/Ge deposited into a stainless steel tape.** Vavra, I.; Korenev, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704834/JAW.

Submitted to the Organizing Committee of the 2. International Conference on Electron-Ray Radiations of CRT-88, Varna, Bulgaria, May 1988.

A surface of superconductive thin film of Nb/sub 3/Ge deposited onto a stainless steel tape was processed using the electron beam technique. The electron beam used had the following parameters: beam current density from 400 to 1000 A/cm/sup 2/; beam energy 100 keV; beam impulse length 300 ns. By theoretical analysis it is shown that the heating of film surface is an adiabatic process. It corresponds to our experimental data and pictures showing a surface remelting due to electron beam influence. After beam processing the superconductive parameters of the film remain unchanged. Roentgenograms have been analysed of Nb/sub 3/Ge film surface recrystallized due to electron beam influence. 6 refs.; 2 figs.

7519 **(LIU-TEK-LIC—1987-21) Construction, characterization and use of a low-energy, ultra-high vacuum compatible, metal ion source.** Hasan, M.A. (Linkoeping Univ. (Sweden). Dept. of Physics and Measurement Technology). May 1987. 10p. NTIS (US Sales Only), PC A02/MF A01 - Also available from: Linkoeping Univ., Dept. of Physics and Measurement Techn., S-581 83 Linkoeping, Sweden.. Order Number DE88756197/JAW.

The design, operation, and use of a low-cost, single grid, electron impact, ultra-high vacuum (UHV) compatible, low-to-medium energy (50-500 eV) ion source capable of operating with medium vapour pressure source material such as Indium is described.

7520 **(SAND—88-2740C) A compact dense plasma focus neutron source for detector calibrations.** Burns, E.J.T.; Falacy, S.M.; Hill, R.A.; Thacher, P.D.; Koehler, H.A.; Davis, B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789;W-7405-ENG-48;AC08-83NV10282. 13p. (CONF-881151—46). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004372/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A 1.4-kJ ultra-clean Mather-type dense plasma focus has produced 14-MeV neutrons on 650 consecutive shots without a misfire and without purging the gas. The average D-T neutron output was (3.4 +- 0.8) {times} $10^9$ neutrons per shot. The D-T neutron pulse was used to calibrate fast-scintillator, photomultiplier neutron detectors. 14 refs., 3 figs., 1 tab.

## 0703 Isotopic Power Supplies

7521 **(CNIC—00176) Measurement of radioactivity of cerium-144 by the $4\pi\beta$-$\gamma$ coincidence parameter method.** Yang Liucheng; Lu Fen; Chen Guoan. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Mar 1988. 4p. (In Chinese). (IAE—0046). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705068/JAW.

A brief description on the measurement of radioactivity of cerium-144 by a $4\pi\beta$-$\gamma$ coincidence parameter method is presented. The result of measurement was compared with that of measurement of radioactivity of cerium-144 by $4\pi\beta$-$\gamma$ coincidence absorber method. The two results agree quiet well.

# 08 HYDROGEN

## 0801 Production

*REFER ALSO TO CITATION(S) 7544, 7604*

7522 **(CRIE-U—87053) Cloning of C.cellobioparum cellulase gene.** Shima, Shigego. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 15p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

As a part of the study of hydrogen production by anaerobic fermentation under the assumption to apply to fuel cell fuel, in order to breed some anaerobic bacteria capable of producing actively hydrogen by degradation of cellulose, the cellulase gene of anaerobic cellulose degradation bacteria C. cellobioparum with affinity to hydrogen production bacteria was cloned using Escherichia coli. Two types of cellulase gene were cloned, and the higher active cellulase gene of them was encoded in 2.7kb fragment in plasmid. The cellulase encoded on plasmid degraded carboxymethylcellulose and p-nitrophenyl-beta-D-cellobioside, however, it was inactive for avicel. Consequently, it was pointed out that the gene was directing the synthesis of endoglucanase. Furthermore, two other types of enzymes, cellubiohydrolase and beta-glucosidase, are necessary to degrade cellulose, so the cloning of these enzymes is remained for furure studies. (8 figs, 1 tab, 14 refs)

7523 **(CRIE-U—87055) Investigation on biophotolytic hydrogen production by chloroplast.** Ishikawa, Haruhiko. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755723/JAW.

Research trends and features of biophotolytic hydrogen production systems by chloroplast were surveyed by literatures. These systems have following features. Since these have a high and stable activity of hydrogen production reaction and a high freedom for system components, the high productivity of hydrogen can be obtained. Since these include no metabolism processes such as respiration and require no energy to keep organism, the high hydrogen conversion efficiency of light energy can be obtained. Since these have no biological phenomena such as growth or propagation, difficult secondary problems can be avoided. Hydrogen production rate is as high as that of cell systems and an energy conversion efficiency reaches 14%, however, the studies are in an early stage. While the studies focus on searching high active biosubstances or clarifying the immobilization or reaction mechanism for activity improvement or stabilization of chloroplast, technological approaches are predicted to develop rapidly in near future. (18 figs, 8 tabs, 14 refs)

7524 **(DOE/PC/90526—8) Partial oxidation of light alkanes in transition-metal ion containing zeolites: [Quarterly report for the period June 15, 1988--September 14, 1988].** Klier, K.; Lin, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90526. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003282/JAW.

The line shape analysis of the E → E optical transitions at 7000 cm/sup {minus}1/ and 25,000 cm/sup {minus}1/ of the dehydrated Co(II)A zeolite has been performed using a model of dynamic Jahn-Teller for the splitting of the E levels. The simulated line shapes have the asymmetric feature in the band of 25,000 cm/sup {minus}1/. The derived force constant K and Jahn-Teller coupling constant A of the ground state were in the reasonable range. However, the energy U/sub o/ for the Jahn-Teller free transitions were too small and about 4000 cm/sup {minus}1/ from the center of the optical band. 7 refs., 6 figs., 2 tabs.

7525 **(INIS-mf—11857) Direct generation of hydrogen in a syngas reactor.** Oertel, M. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 2 Sep 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756104/JAW.

The author investigated a process of direct hydrogen production from natural gas or coal in a syngas reactor. The methane conversion rate can be raised to more than 90% by integrating palladium permeation membranes in a reformer for steam cracking of natural gas using HTR process heat. If the dry product gas is emitted as lean gas, further treatment of the gas becomes unnecessary. The resulting high-purity hydrogen has a low pressure level and must be compressed. With direct withdrawal of hydrogen, the kinetics of carbon conversion is improved, and the formation of methane inside the gas generator is largely suppressed. This results in a decrease of the mean reaction temperature and an increase in the integrable helium heat of the HTR. The hydrogen yield as referred to the initial carbon volume can be increased significantly. In addition, the process will require less process steam.

7526 **(N—89-10826) Methods of extracting hydrogen from lunar soil. Final technical report, 1 April-31 October 1988.** Bustin, R. (Arkansas Coll., Batesville (USA)). Oct 1988. 8p. (NASA-CR—180465; NAS—1.26:180465). NTIS, PC A02/MF A01.

Increasing interest in establishing a lunar base has generated considerable study on the utilization of lunar resources. Because of its importance in producing water, reducing oxides, and serving as a fuel for orbital tranfer vehicles, hydrogen is of prime importance as a resource. Lowman (1985) states that hydrogen would greatly facilitate the establishment of an autonomous permanent colony, and he calls hydrogen the most valuable lunar resource. Through the centuries, hydrogen has been embedded in lunar soil by the solar wind. The hydrogen can be extracted by heating the soil to 900 C (Carr et al, 1987). In order to obtain hydrogen on the lunar surface, an extraction method must be developed which will not only be reliable but also economically feasible. Three heating methods are examined for possible use in extracting hydrogen from lunar soil.

7527 **(SERI/TP—220-3418) Hydrogen production by photoprocesses.** Bull, S.R. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1988. Contract AC02-83CH10093. 14p. (CONF-880932—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE88001198/JAW.

From International renewable energy conference; Honolulu, HI, USA (18 Sep 1988).

The concept of producing hydrogen fuel from sunlight is inherently appealing and has captured the imagination of many scientists, innovators, and decision makers. In fact, there are numerous routes to produce hydrogen from solar energy through photoprocesses. Generally, they can be grouped into four processes: electric conversion, thermal conversion, indirect conversion, and direct photon conversion. 12 refs., 11 figs.

## 0802 Storage

*REFER ALSO TO CITATION(S) 8131, 8192, 8253*

7528 **(BNL—41483) Metal hydride slurries.** Reilly, J.J.; Johnson, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-8808162—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002940/JAW.

From International workshop on metal hydrides for hydrogen storage, purification and thermodynamic devices; Stuttgart, F.R. Germany (31 Aug 1988).

This research focuses primarily on the isothermal kinetics of the absorption and desorption of hydrogen by $LaNi_5H_x$ suspended in an inert, hydrocarbon solvent (n-undecane or n-octane). It is also aimed at providing an insight into the behavior and properties of such suspensions which will, hopefully, facilitate their practical exploitation. 12 refs., 1 tab.

7529 (INIS-mf—11860, pp 28-56) **Studies on selective hydrogen implantation in metals.** Block, F.R.; Bahs, H.J. (Technische Hochschule Aachen (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

This research project is intended to prepare basic conditions for technical processes in which hydrogen is selectively absorbed from technical gas mixtures and then released under increased pressure. In particular, it aims at finding out which accompanying gases in hydrogen ($CH_4$, $N_2$, CO, $CO_2$, $H_2O$ vapour, $SO_2$, $H_2S$) are compatible with the different hydride-forming alloys and which gases lead to a passivation or poisoning of the storage alloys.

7530 (INIS-mf—11860, pp 75-82) **Solubility of hydrogen in Ti alloys.** Mrowietz, M.; Weiss, A. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Physikalische Chemie). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The solubility of hydrogen in alloys such as $Ti_{1-x}Ga_x$, $0 \leqq x \leqq 0.25$ within the pressure range of $5.10^{-5} \leqq P_{H_2}/\text{bar} \leqq 1$ and the temperature range of $773 \leqq T/K \leqq 1298$ was studied. The phase diagram $Ti_{1-x}Ga_xH_r$ for 9 different compositions x was examined within the P,T ranges mentioned. Solution enthalpies were determined. A model was developed which takes into account the blocking of interstitials by hydrogen, and considers the volumes of the interstitials. In this way, the excess entropy of the dissolved hydrogen can be determined. The measurements were extended to cover the $\alpha$-$Ti_3Sb$ $H_r$ system, and the model was used to rationalize all the current solubility data for hydrogen in titanium alloys. Measurements in the Ti-P-H system were also effected.

7531 (INIS-mf—11860, pp 212-221) **Segregation and separation (cluster formation) in the treatment of TiFe with hydrogen.** Wicke, E.; Hempelmann, R. (Muenster Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

7532 (INIS-mf—11860, pp 268-282) **Processes in the surface area of intermetallic, hydrogen-storing compounds.** Sicking, G.; Albers, P.; Jungblut, B. (Essen Univ. (Gesamthochschule) (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

7533 (N—89-10184) **Rechargeable metal hydrides for spacecraft application.** Perry, J.L. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Sep 1988. 37p. (NASA-TM—4076; M—598; NAS—1.15:4076). NTIS, PC A03/MF A01.

Storing hydrogen on board the Space Station presents both safety and logistics problems. Conventional storage using pressurized bottles requires large masses, pressures, and volumes to handle the hydrogen to be used in experiments in the U.S. Laboratory Module and residual hydrogen generated by the ECLSS. Rechargeable metal hydrides may be competitive with conventional storage techniques. The basic theory of hydride behavior is presented and the engineering properties of LaNi5 are discussed to gain a clear understanding of the potential of metal hydrides for handling spacecraft hydrogen resources. Applications to Space Station and the safety of metal hydrides are presented and compared to conventional hydride storage. This comparison indicates that metal hydrides may be safer and require lower pressures, less volume, and less mass to store an equivalent mass of hydrogen.

# 09 OTHER SYNTHETIC AND NATURAL FUELS

## 0901 Hydrocarbon Fuels

*REFER ALSO TO CITATION(S) 8531*

7534 (ACIESP—60(v.4), pp 38-46) **Radioimmobilization of biocomponents.** Higa, O.Z. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE88704677/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

A number of different methodologies are available using radiation processing for the immobilization of biomolecules such as enzymes, antibodies, drugs and transport proteins such as haemoglobin. A simple method which is currently used is the physical immobilization by entrapment in polymer matrix produced by radiation polymerization of a mixture of monomer and bioactive material. Compared with other techniques for immobilization, the radiation polymerization method for the preparation of a matrix is facile and the products have showed good activity and stability (E.G.).

7535 (AGARD-CP—422, pp 6) **Performance of a surrogate blend in simulating JP-4 in a spray-fueled combustor.** Samuelsen, G.S.; Wood, C.P. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A surrogate fuel was developed to simulate the atomization and combustor performance of a practical distillate JP-4. The surrogate is comprised of 14 pure hydrocarbons and formulated based on the distillation curve and compound of the distillate parent. In previous work, the atomization performance (evaluated in terms of the atomization quality in an isothermal chamber), and the combustor performance (evaluated in terms of the velocity and thermal fields in a spray fueled combustor) were found to be equivalent for the parent and surrogate JP-4. The sooting performance of the two fuels is addressed, as well as two reference fuels (a JP-5 and isooctane) of purposefully disparate properties. The sooting performance of the parent and surrogate JP-4 are nearly identical, and distinctly different from that of either the JP-5 or the isooctane. The surrogate represents, as a result, an attractive fuel blend for the study of fuel compositional effects on the sooting performance of petroleum fuels in spray fueled combustor.

7536 (AGARD-CP—422, pp 11) **Behaviour of synthetic fuels in a small transparent combustor.** Odgers, J.; Kretschmer, D. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

In a continuing program on the effects of fuel properties on combustion, some 20 pure hydrocarbons and synthesized fuels were tested at atmospheric conditions in a small transparent combustor. This combustor used a very efficient air assist atomizer, such that droplet size was nearly constant. Each fuel was burned over a range of air/fuel rations, and at each condition, a full exhaust gas analysis was done, exhaust temperature distribution was measured, as also flame radiation and weak extinction. The results and their implications are discussed.

7537 (DOE/CH/10093—25) **Five year research plan, 1988--1992: Biofuels: Renewable fuels for the future.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1988. Contract AC02-83CH10093. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88001181/JAW.

This five-year research plan sets forth the research activities of the US Department of Energy's (DOE) Biofuels and Municipal Waste Technology Program for 1988 through 1992. These research activities are necessary to provide versatile, renewable substitutes for oil and natural gas, the fossil fuels that power much of the world. In developing and implementing this plan, DOE and several of its laboratories are working closely with university, industrial, and other federal and local government research organizations. The Biofuels and Municipal Waste Technology Program focuses on the production of liquid fuels such as alcohol fuels, biocrude-derived gasoline, and plant-oil-drived diesel fuel, and gaseous fuels such as biogas and syngas. These fuels can be produced from many plant materials and from certain waste products such as municipal waste. These raw materials, or feedstocks, together are called biomass.

7538 (DOE/PC/80015—12) **Fischer-tropsch slurry phase process variations to understand wax formation: Quarterly report for period July 1, 1988 to September 30, 1988.** Donnelly, T.; Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1988. Contract AC22-85PC80015. 44p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003247/JAW.

A precipitated iron catalyst without any alkali promoters was studied for 2000 hours on stream in a slurry reactor. Reaction conditions were 230 to 260{degree}C (mostly 260{degree}C), 0.77 to 1.92 MPa, $H_2/CO$ feed ratios of 0.5 to 2.0 and $CO + H_2$ conversions of 10% to 65%. A Schulz-Flory carbon number distribution with two chain growth probabilities was required to describe the product. Effects of operating variables on 1-butene/n-butane ratio, methane and oxygenate selectivities, and $\alpha_1$ and $\alpha_2$ are reported. Kinetic models for secondary reactions of 1-alkenes were developed. Addition of potassium t-butoxide to the reactor substantially shifted both distributions to heavier products. 19 refs., 17 figs., 4 tabs.

7539 (DOE/PC/88861—T4) **Metallic glasses as selective catalysts for synthesis of hydrocarbon liquids in high sulfur conditions: Quarterly report, 1 July--31 September 1988.** Brower, W.E. Jr. (Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes). 1988. Contract FC22-88PC88861. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003322/JAW.

The overall objective of this project is to develop a more sulfur- resistant catalyst for indirect liquefaction of coal. During this quarter the $Fe_{80}B_{20}$ metallic glass was evaluated in the cryo-milled condition. The surface area of the glass was increased from 0.02 to about 1 $m^2/g$. This increase allowed measurable activities for the 50mg samples used in the catalytic measurements. Results of gas chromatograph analyses of the Fischer-Tropsch reaction products are also reported. 4 tabs.

7540 (DOE/PC/90014—T1) **Upgrading of light Fischer-Tropsch products: Quarterly report No. 5, October 1, 1987--December 31, 1987.** (UOP, Inc., Des Plaines, IL (USA)). 10 Oct 1988. Contract AC22-86PC90014. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003392/JAW.

Work during this quarter concentrated on Task 4 of the study. The objective of this task is to evaluate the application of the BP/UOP Cyclar* process to the upgrading of Fischer-Tropsch LPG products into aromatics. Task 4.0 is divided into three major

subtasks: 4.1 - Huels CSP Study; 4.2 - Indirect Cyclar Processing; and 4.3 - Direct Cyclar Processing. In the "Direct" Cyclar route, Fischer-Tropsch LPG is fed directly to the Cyclar unit. In the "Indirect" route, the LPG is first processed by Huels CSP to reduce the olefin content and then sent to the Cyclar unit. The Direct and Indirect Cyclar processing schemes are depicted. 1 fig., 3 tabs.

7541 **(ENEA-RT-FARE—88-1) Biogas from landfills: Economic aspects.** De Poli, F.; Gamboni, M.; Pasqualini, S. (ENEA, Rome (Italy)). Apr 1988. 19p. (CONF-8710399—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755362/JAW.

From International symposium on process, technology and environmental impact of sanitary landfill; Cagliari, Italy (19 Oct 1987).

An analysis of 9 cases in Italy shows a very high net present worth/initial investment ratio and a production cost of 10-40 US$/tpe. In many countries extraction is mandatory for security and legal problems. The utilization of this renewable energy source can be profitable; but the true value of the biogas extracted from landfills is strictly connected with the utilization rate.

7542 **(FEC—C-92) Evaluation of fuels for operation of a fixed bed, downdraft, commercial gasifier.** (Friends of the Earth, Ottawa, Ontario (Canada)). 1981. 110p. (CE—02101). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was conducted to evaluate and optimize the performance of a commercial fixed-bed downdraft gasifier. Gasifier performance was examined using three different size classes of clean aspen and pine wood chips. In addition, tests were conducted using chips mixed with either 25 or 40% residues, including pine bark, sawdust, and shavings. Three runs were also conducted using mini-rotation hybrid poplar whole-tree chips. Runs were conducted at varying feedstock moisture contents; gasifier air flow and grate rotation were varied to optimize the performance of the gasifier while operating on different feedstock fuels. It was found that feedstock moisture content was the most important factor affecting thermal efficiency of the gasifier. High fuel moisture content reduced both overall gas quantity and quality. High air flow was found to be detrimental to the gasfication of small chips. High air flow tended to result in exessive char carryover. A high grate rotation also resulted in a fast throughput of feedstock. This was especilly noticeable with the small chip sizes. Although the bark, sawdust, shaving-chip mixes and mini-rotation hybrid poplar whole-tree chips were found to be suitable for gasification, serious problems were encountered with feeding these materials. The downdraft gasifier was thus not considered adequate for operating of these types of bulky residues. 9 refs., 9 figs., 38 tabs.

7543 (KFK-PEF—35-Vol.1, pp 197-207) **Physiological and biochemical studies on the emission of terpenes of Picea abies.** Juettner, F.; Bufler, U. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The incorporation of /sup 13/CO/sub 2/ was applied to gain some insight into the dynamics of mono- and sesquiterpenes of Picea abies. Combined gas chromatography-mass spectrometry was used to determine the labelling of individual terpenes. The mole percentage of the label was as high as 85 (mol %). The experiments showed that only young needles are capable to synthesize efficiently monoterpenes. Synthesis of monoterpenes in 1- and 2-year-old needles was not detectable. In addition, effective degradation processes and/or biotransformations of monoterpenes were not found in the needles. Monoterpenes labelled in the 6 positions were the most abundant species. This points at a restricted randomization of the C-atoms. The pattern of label in the emitted monoterpenes will be used to gain some insight into different pools of emission.

7544 **(PB—89-100499/XAB) Limits of thermochemical and photochemical synthesis of gaseous fuel: a finite-time thermodynamic analysis. Final report, January 1, 1984-December 31, 1986.** Berry, R.S. (Chicago Univ., IL (USA)). 5 Apr 1988. 117p. NTIS, PC A06/MF A01.

See also PB—87-215695.

A method was developed for systemic evaluation of the optimum performance of proposed or realized processes of fuel synthesis. Based on thermodynamic criteria but taking rate-dependent constraints into account, the procedure permits comparisons of potentially competitive processes. Illustrative applications were made to thermal, photochemical and electrochemical processes; direct thermal processes are studied in detail. The method is intended for guidance in the selection of a research portfolio. The results of the study lead to the recommendation that direct thermal generation of hydrogen by presently known means should not be part of a research portfolio for GRI. Other results include the optimization of ammonia synthesis, the analysis and optimization of a new kind of solar engine, a method for analyzing nonlinear differential equations for stability conditions and a new view of the possible cause of several related effects in biological photosynthesis.

7545 **(PB—89-102818/XAB) Laboratory study of thermal-desorption treatment of contaminated soils from former manufactured-gas plant sites. Topical report.** Helsel, R.W.; Groen, A. (IT Corp., Knoxville, TN (USA)). Aug 1988. 139p. NTIS, PC A07/MF A01.

To evaluate and develop technologies which are potentially applicable for remediation of former manufactured gas plant (MGP) sites, bench-scale treatability tests of thermal desorption were performed. Soil samples from four MGP sites were characterized and subjected to various time-temperature conditions in a static laboratory oven. Residual concentrations of polynuclear aromatic hydrocarbons, phenols and cyanide were measured and compared to initial levels to establish the relationship between removal efficiency and treatment conditions. The report presents the test results and describes the experimental procedures.

7546 **(PB—89111603/XAB) Methods of zonation for rural energy resources. Technical report.** Xu, S. (Chinese Academy of Agricultural Engineering Research and Planning, Beijing, BJ). 1987. 10p. NTIS, PC E03/MF A01.

Energy resources are the important material basis of the national economy. Rural energy resources are directly concerned in the development of agricultural production, the raising of the peasants living standard and the improvement of the agro-ecological environment. In this paper mono-zonation of biogas and synthetic zonation of rural energy resources are described as examples. The zonation of bio-gas utilization is based on the regional differences and on the necessity and possibility for the development of biogas. Different types of biogas zones are thus delimited. The synthetic zonation of rural energy resources is based on the total-energy-measurement method. The quantities of energy resources in each zone add together according to the unified measurement unit so as to delimit zones with abundant energy resources and those with insufficient energy resources. Then, the leading-factor method is used to analyze and determine one of the energy resources that has the greatest potential in a certain zone and the others that are auxiliary energy resources, explore the possibility of establishing a system in which a variety of energy resources supplement each other, and define the emphasis and process for development.

7547 **(PB—89111850/XAB) Study on economic heating source for mesophilic fermentation in a rural biogas plant. Technical report.** Gu, D.; Fang, Z. (Chengdu Univ. of Science and Technology, SC (China)). 1987. 10p. NTIS, PC E03/MF A01.

This paper introduces a new technology making a rural biogas plant of mesophilic fermentation, the key of which is a set of efficient installations recovering waste heat from a biogas-diesel engine. The system exhausts no extra energy and waste heat recovered from the engine can entirely make compensation for a heat loss of the biogas plant, which is an economic heating source for mesophilic fermentation. The new technology could make a great

contribution to yearlong steady efficient output of a rural biogas plant and make biogas a reliable energy resource in the countryside.

7548 **(PB—89111876/XAB) Experiment and research on mesophlic anaerobic digester with dairy cattle manure in northern China. Technical report.** Tang, W.; Wang, M. (Chinese Academy of Agricultural Engineering Research and Planning, Beijing, BJ). 1987. 14p. NTIS, PC E03/MF A01.

To treat animal wastes with the technology of anaerobic digestion can reduce environmental pollution and generate energy -- biogas, as well as produce a quick-acting, toxic-free fertilizer. The temperature in Northern China is comparatively low, to obtain a high biogas productivity, quick digestion of animal wastes in short period of time and high energy output in mesophilic fermentation poses a question. The answer is to create favorable conditions and environment for methanelization, i.e., rational process for biogas fermentation and advanced engineering system. The Gold Star Dairy Farm is located in the southern suburbs of Beijing. The 336 dairy cattle of the farm produce 10 tons of manure dairy, equivalent to 3600 tons of manure annually. A 300 cu m mesophilic digester system was established and started operation in the summer of 1984. In the two years of operation, the digester treats 6 ton manure and produces 180-200 cu m biogas eachday. Apart from heating and cooking for a canteen, the biogas produced can generate 150 kWh electricity, which is utilized for milking and refrigeration of milk products. In addition, the biogas effluent can be used as fertilizer for farm land and feed for fish raising.

7549 **(PB—89111884/XAB) Root causes and preventive measures of cracks within the concrete biogas digester. Technical report.** Fang, G. (Ministry of Agriculture, Animal Husbandry and Fishery, Chengdu, SC (China)). 1987. 10p. NTIS, PC E03/MF A01.

The concrete digester improvements the rural hygienic condition. So it has been the most sophisticated and warmly welcomed by the peasants. This paper discusses how to enhance and guarantee the quality of the concrete digester and suggests the root causes and preventive measures of the structural crack within the concrete digester. Based on the on-the-spot investigation in fourteen provinces since 1982, the author thinks that the problem is universal in China.

7550 **(PB—89111892/XAB) Study of biogas storage installation for household. Technical report.** Zhang, D. (University of Agricultural Engineering, Beijing, BJ (China)). 1987. 9p. NTIS, PC E03/MF A01.

A biogas storage installation is one of the necessary parts of the biogas-producing process. This paper analyzes the problems of a few biogas storage-installation constructions used in the biogas field and introduces a flexible type of rolling-axis bag for storing biogas. This kind of storage installation has the advantages of easy construction and operation, low cost, and a constant pressure for cooker burning.

7551 **(PB—89111900/XAB) Study on compressed biogas and its application to the compression-ignition dual-fuel engine. Technical report.** Jiang, C.; Liu, T.; Zhong, J. (Zhejiang Agricultural Univ., Hangzhou, ZH (China). Agricultural Engineering Dept.). 1987. 12p. NTIS, PC E03/MF A01.

This paper introduces in detail the compression performance of biogas, the application of compressed biogas to the compression-ignition engine and the possibility as well as the necessity of using compressed biogas. Moreover, the paper also goes further into some problems about the power increasing, efficiency raising and their social, economic and ecological beneficial results, when the compressed biogas is used in the compression ignition-dual fuel engine.

7552 **(PB—89115240/XAB) Co-treatment of manufactured gas plant site ground waters with municipal waste waters. Final topical report, June 1987-August 1988.** Smith, J.R.; Weightman, R.L. (Keystone Environmental Resources, Inc., Monroeville, PA (USA)). Aug 1988. 230p. NTIS, PC A11/MF A01.

A pilot-scale treatability study was performed to evaluate the capability to effectively treat Manufactured Gas Plant (MGP) site waters using activated sludge biological treatment. The study assessed the effect of co-treatment of MGP site waters on conventional activated-sludge treatment-system operations. Purgeable aromatics, phenolics, metals, and polynuclear aromatic hydrocarbons were the chemicals-of-interest for three environmental fate mechanisms: volatilization, adsorption, and biodegradation. The results support that the addition of MGP site groundwaters into municipal wastewater streams will result in nonmeasurable effects in terms of activated sludge treatment performance, and nonsignificant effects in terms of treated discharge quality.

7553 **(QU—1981) Development of a technical basis for assessing wood gasifier design and operation.** Bacon, D.W.; Downie, J.; Hsu, C.C.; Peters, J.A. (Queen's Univ., Kingston, Ontario (Canada)). 1981. 255p. (CE—02100). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A computer simulation program has been developed as a basis for assessing the performance of a sand fluidized-bed wood gasifier. The program uses the Modified Bubble Assemblage Model for fluidization, and assigned degrees of approach to equilibrium for the gasification reactions. It is designed to be used as an interactive microcomputer. Detailed program listing, flow charts, algorithms, explanatory notes, and procedures for running the program are included. The input of the program consists of the design specifications of the gasifier, the operating conditions, and a set of model parameters. The output includes the product gas composition, flowrate, and calorific value, and the temperature profile in the bed. Simulation runs were made using industrial conditions, and the results are in reasonable agreement with the limited amount of data available. Sensitivity analyses were carried out on the model parameters, operating variables and design variables. The most important operating variable is the oxygen-to-dry wood ratio. When the effect of this ratio is accounted for, the moisture content of the wood is found to have only a minor effect on the calorific value of the product gas. The design variables have a negligible effect on the product gas composition within the range tested. This implies that the design variables may be set solely for stable operation. 26 refs., 24 figs., 18 tabs.

7554 **(WU—C-28) The flash pyrolysis of wood in a bench-scale fluidized bed.** Scott, D.S. (Waterloo Univ., Ontario (Canada)). 1981. 128p. (CE—02096). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An apparatus has been developed to investigate the decomposition of wood or other biomass materials under flash pyrolysis conditions at atmospheric pressure with an objective of obtaining maximum liquid yields. A small fluidized bed of sand is fed continuously to the fluidized bed at about 15 g/h by means of an entrained flow feeder of unique design, developed in this work. The operating characteristics of this feeder have been investigated, both at atmospheric pressure and at pressures to 7 megapascals. Very successful routine operation of the flash pyrolysis unit has been attained with good material balances and organic liquid yields up to 65% of the dry wood weight fed. 8 refs., 62 figs., 16 tabs.

7555 **Process for converting light alkanes to higher hydrocarbons.** Noceti, R.P.; Taylor, C.E. (to Dept. of Energy, Washington, DC). US Patent 4,769,504. 6 Sep 1988. Filed date 4 Mar 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a process for converting a lower alkane to higher hydrocarbons in stages comprising: passing a reaction mixture including the lower alkane, HCl and O/sub 2/ into contact with an oxyhydrochlorination catalyst to form an intermediate gaseous mixture included chlorinated alkanes and water; drying the intermediate gaseous mixture to less than about -40°C dew point; passing the dried intermediate gaseous mixture into contact with a crystalline aluminosilicate catalyst at a temperature in excess of 200°C to form a product mixture containing dry HCl and higher hydrocarbons than the alkane; separating the dry HCl from the product mixture and recycling the HCl for reaction with the

lower alkane and oxygen in the presence of the oxyhydrochlorination catalyst.

**7556 Viscosity and density of some lower alkyl chlorides and bromides.** Rutherford, W.M. (Monsanto Research Corp., Mound, Miamisburg, OH (US)). *Journal of Chemical and Engineering Data;* 33: No. 3, 234-237(Jul 1988).

A high-pressure capillary viscometer, used previously to measure the viscosity of methyl chloride was rebuilt to eliminate the first-order dependence of the measured viscosity on the value assumed for the density of the fluid being investigated. At the same time, the system was arranged so that part of the apparatus could be used to measure density by a volumetric displacement technique. Viscosity and density were measured for ethyl chloride, 1-chloropropane, 1-chlorobutane, methyl bromide, ethyl bromide, and 1-bromopropane. The temperature and pressure ranges of the experiments were 20-150 °C and 0.27-6.99 MPa, respectively. The accuracy of the viscosity measurements was estimated to be +-1% and of the density measurements, +-0.2%.

## 0902 Alcohol Fuels

*REFER ALSO TO CITATION(S) 7537*

**7557 (BEI—1980) Photosynthesis, the mother of life. First Canadian national power alcohol conference, 1980.** (Biomass Energy Inst., Inc., Winnipeg, Manitoba (Canada)). 1980. 365p. (CONF-8006185—; CE—02121). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From Canadian national power alcohol conference; Winnipeg, Canada (20 Jun 1980).

A conference was held in Canada to review current developments in the production, use, and promotion of alcohol as an alternative fuel. Papers were presented on government policies regarding alcohol fuel development, economics of alcohol fuel production and subsidization, alcohol fuel-related research programs, legal aspects, fermentation, ethanol production from agricultural resources and from hemicellulose, fuel alcohol policies and production around the world, fuel substitution, low-energy alcohol production processes, hydrolysis of carbohydrates, methanol production, and the use of alcohols in internal combustion engines. Separate abstracts have been prepared for 23 papers from this conference.

**7558 (DOE/ER/13290—4) Selectivity of the reactions of oxygenates on transition metal surfaces: Progress report, 15 December 1987--14 December 1988.** Barteau, M.A. (Delaware Univ., Newark (USA)). 1988. Contract FG02-84ER13290. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003691/JAW.

The goal of this research has been to understand, by means of surface science studies, the elementary processes involved in the synthesis of methanol and higher alcohols on transition metals, and the dependence of these processes upon the nature of the surface. To date we have completed TPD and HREELS studies of methanol, formaldehyde, formic acid, methyl formate, ethanol, acetaldehyde, acetic acid, 1-propanol, propanal, propionic acid, 2-propanol, acetone, allyl alcohol, acrolein, acrylic acid, and propylene on clean and oxygen-dosed Pd(111) surfaces. We have completed TPD, HREELS, and XPS studies of methanol, formaldehyde, and formic acid on clean and oxygen-dosed Rh(111) surfaces. 4 refs.

**7559 (DOE/PC/90013—T6) Optimum catalytic process for alcohol fuels from syngas: Sixth quarterly technical progress report, April--June, 1988.** Dombek, B.D. (Union Carbide Corp., South Charleston, WV (USA). Solvents and Coatings Materials Div.). 29 Jul 1988. Contract AC22-86PC90013. 58p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89002733/JAW.

Objectives are to discover and evaluate the catalytic properties of combination catalytic systems for the production of alcohol fuel extenders from syngas, to evaluate analytically and on the bench scale novel reactor concepts for use in converting syngas to liquid fuel products, and to develop on the bench scale the best combination of chemistry, reactor, and total process configuration to achieve the minimum product cost for conversion of syngas to liquid fuel products. The study of additional additives to the homogeneous ruthenium catalyst in the search for improved activity continued. Certain Mo and Ir compounds slightly increased the selectivity to higher alcohols. Platinum, copper, and palladium compounds tested are severe catalyst poisons. Phosphine compounds tested either retard the catalyst activity slightly or completely poison the system. Chemical model studies have been carried out to investigate the mechanism of homogeneous hydrogenation of CO. Results indicate that the first interaction between hydrogen and CO could be a reaction between a metal hydride and an activated carbon monoxide ligand bonded to a metal center. Investigations into improving the performance of alkali-loaded molybdenum sulfide based catalysts have continued. Also, experiments have tested a number of alternative procedures for the preparation of fuel alcohol catalysts. None of the catalysts tested has been superior to the standard catalysts. $MoS_2$ with higher surface area has been prepared by changing the ammonium tetrathiomolybdate preparation procedure and stopping the $H_2S$ feed sooner. Catalysts prepared by low temperature calcination to first produce $MoS_3$, then impregnating and calcining were little different from the standard except for slower a rate. Two catalysts were prepared from ammonium tetrathiomolybdate precipitated by a process yielding fine particles. Neither gave improved rate or selectivity. 14 figs., 8 tabs.

**7560 (FHWA/RD—86/117) CMA manufacture II: Improved bacterial strain for acetate production: Final report.** Ljungdahl, L.G.; Carreira, L.H.; Garrison, R.J.; Rabek, N.E.; Gunter, L.F.; Wiegel, J. (Federal Highway Administration, McLean, VA (USA). Turner-Fairbank Highway Research Center; Georgia Univ., Athens (USA). Research Foundation). Jun 1986. 118p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89003074/JAW.

Three homoacetogenic anaerobic thermophilic bacteria, Clostridium thermoaceticum, Clostridium thermoautotrophicum, and Acetogenium kivui, were evaluated for possible use in an industrial fermentative process to manufacture calcium, magnesium acetate (CMA) from hydrolyzed corn starch and dolime. The hydrolyzed corn starch is fermented by the bacteria with a theoretical yield of about 90%. Improved bacterial strains were obtained from the clostridial bacteria but not from A. kivui. In fermentations with improved bacterial strains using dolime to neutralize the produced acetic acid, up to 150 g/liter of CMA was produced, however, the production rate was only about 12 g/liter per 24 hours. Batch fermentation, continuous fermentation with and without cell-recycling and continuous fermentation with a new type of rotating fermentor were tested. Economic evaluation of the results indicate that CMA can be produced for $0.24/lb. The rotating fermentor device was developed at the end of the contract period. With it a production rate of almost 10 g/liter an hour was obtained, however, the concentration of acetate in the harvested fermentation broth was only 1 percent. Further research should lead to the development of an economic fermentation process for CMA. 38 refs., 10 figs., 34 tabs.

**7561 (NP—9770168) Catalytic conversion of methanol on polycrystalline nickel films, investigated by means of photoelectron spectroscopy in UHV molecular beam experiments.** Krall, W.R. (Hamburg Univ. (Germany, F.R.). Fachbereich Physik). 1986. 149p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770168/JAW.

The interaction of CH/sub 3/OH-molecules with a polcrystalline nickel-surface has been studied using photoelectron spectroscopy and mass-spectrometry in an ultra high vacuum system. The gas inlet device consisted of a molecular nozzle beam, able to create a particle-pressure of 10/sup -2/ Pa at the sample surface, while the ultra high vacuum of about 10/sup -8/ Pa, necessary for photoelectron spectroscopic investigations, was sustained in the environment of the sample. Under these conditions the reaction steps of the conversion of methanol to hydrocarbons could be investigated in situ by surface-sensitive spectroscopies and the evaluation of the relevant parameters was possible. Among these the enrichment of the near surface regions of the sample with the reaction product is most important. Trapped at atomic defects, hydrogen can promote the methanol conversion to hydrocarbons.

## 0904 Solid Waste And Wood Fuels

*REFER ALSO TO CITATION(S) 7537*

**7562 (AE—C-221) RF transmission line methods for feedstock moisture content determination. Phase 2.** (Industrial Disease Standards Panel, Toronto, Ontario (Canada)). 1981. 52p. (CE—02097). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The object of this study was to confirm experimentally that radio-frequency transmission line phase methods could be used for accurately determining the moisture content of wood waste feedstocks moving on a conveyor belt. Another goal was to conduct preliminary circuit design of radio-frequency source and phase measuring electronics. Testing was done using a box jig and a belt jig. The box jig consisted of a plywood box mounted on rollers which allowed it to be moved past a transmission line sensor, with the spacing between the box base plane and the sensor able to be varied at will. The jig design permitted independent and selective variation of test parameters such as frequency, vibration, velocity, moisture content, and volume. In the belt jig, sensor bars were placed under a plexiglass layer underneath a conveyor belt section, and used to study the effects of belt motion, dielectric properties, and various moist materials on the belt. It was found that the frequency of operation should be in the 300-400 MHz range for ease of implementation, small sensor size, high sensitivity, and freedom from perturbation by movement of other objects. The sensor system was extremely sensitive to vibration, or variation in the sensor/material gap. In an operating conveyor belt system, the sensor would probably be placed in contact with the bottom of the belt and spring-mounted to insure a snug fit. An overall conveyor belt system sensitivity of ca 0.5 degrees per percent change of moisture content should be attainable. 18 figs.

**7563 (EEA—8708) Data analysis and report preparation on a bioenergy self-sufficient system.** Huffman, D.R. (Ensyn Engineering Associates, Inc., Ottawa, Ontario (Canada)). 1987. 46p. (MICROLOG—88-06249). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A small hardwood sawmill complex was constructed in Nova Scotia to produce mine timbers from a local resource of unutilized maple and birch logs. A total mill residue utilization concept was included in the plant design. Hog fuel was burned in twin packaged boilers to provide steam to a turbogenerator for mill electrical energy. Sawdust and pulverized solid trim were dried in a wood-fired flash dryer and densified in a dual-line ram press system that produced fuel-logs for the home heating market. Although financial difficulties forced closure of the mill before full capacity operation of the fully integrated complex had been achieved, the project had demonstrated that small-scale energy self-sufficiency and total residue utilization were not technically limited. The constraints on implementation were largely economic with financial viability dictated by utilization factors. 9 refs., 1 fig., 11 tabs.

**7564 (FCC—8709) Design, build and evaluate the Forintek moisture sensor for measuring on-line moisture content (MC) in unseasoned lumber and hog fuel.** Warren, S.R.; Troughton, G.; Ward, M. (Forintek Canada Corp., Vancouver, British Columbia. Western Forest Products Lab.). 1988. 31p. (MICROLOG—88-06248). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A new plant prototype moisture sensor was designed, built and tested for sorting unseasoned lumber on a commercial scale. In addition, a laboratory model was designed, built and tested to measure the moisture content of hog fuel to ascertain the daily, weekly and monthly fluctuations for boiler operations in pulp plants. The principal of the new moisture sensor is based on the relationship between moisture content and surface temperature rise after the material has received a known quantity of heat energy. A preliminary mill trial for sorting lumber was conducted at a British Columbia plant, to establish the economics of sorting and whether the mill should proceed with a commercial run. The results of the preliminary trial based on economics were sufficiently promising to warrant a large commercial trial. The savings based on grade outturn and recovery on 100,000,000 bd ft are over one million dollars. The daily, weekly and monthly fluctuations of the hog fuel indicated that the moisture sensor could be used in pulp mills to monitor boiler operations. 13 refs., 14 figs., 6 tabs.

**7565 (INTEG—1980) Study of hog fuel drying systems.** (INTEG, Vancouver, British Columbia (Canada)). 1980. 93p. (CE—02099). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents the results of a broad survey of equipment commercially available in North America for hog fuel drying. A general description and brief technical evaluation are provided for each drying system and combustion system surveyed. Only those systems proven on hog fuel service, or proven on products with compatible properties to hog fuel, were selected for evaluation. Each system has been considered in 3 sizes, with capacities to suit the requirements of gasifiers in the size range of 10-60 million Btuh. Special attention is paid to economics in dryer systems and fuel preparation requirements in combustor systems. Three types of dryers - rotary drum, flash, and hot conveyor - are considered. Rotary dryers are the least sensitive to particle size of the dryer styles surveyed, and have the highest capacity and highest possible fire hazard. Flash dryers, operating on very fine material and at high air temperatures with low retention times, have less fire hazard than rotary dryers but lower capacity. They are well adapted to predrying hog fuel for power boilers. Hot conveyors use drying gas in crossflow, with minimal mechanical agitation and the lowest fire hazard of the three dryer types; they are very suitable for friable material. Four types of combustors are evaluated: suspension burners, single chamber combustors, multiple chamber combustors, and fluidized bed combustors. 7 figs., 12 tabs.

**7566 (LBH—C-87) Development of a moisture resistant densified solid fuel from forest biomass.** Levelton, B.H. (Levelton (B.H.) and Associates Ltd., Vancouver, British Columbia (Canada)). 1981. 160p. (CE—02094). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Tests using a laboratory punch press identified the process conditions that could produce a water-stable product from moist pulverized wood and bark, from pulverized wood and lignin-rich binders, and from steam-exploded aspen wood. A process scheme involving heating, flash drying, and cooling was used in the systematic tests because of the superior quality of the product. The minimum temperatures and pressures and the range of moisture contents needed to form a water-stable product from the above materials were established. Evaluations were made of various types of biomass densification equipment to determine if they could be used to produce a water-stable product. Special attention was paid to a machine producing fuel logs by the BC Research Process. A study of available data for this machine showed that the moist wood residues were raised to temperaures and pressures similar to those determined to produce water stability in the laboratory equipment. Four possible routes exist for producing a water-stable product commercially: feed steam-exploded wood to a pellet mill; use the BC Research machine modified to produce briquets; feed heated moist residues under pressure to an extrusion device and heat the dense product by conduction and radio-frequency methods; or, feed moist residues to a multi-platen stack press of the design used for fiberboards, to produce dimpled boards which could be broken into fuel-size pieces. Further research is recommended into the modified extrusion machine (for low to medium production rates) and the fiberboard technology method (for high production rates). 18 refs., 64 figs., 22 tabs.

7567 **(NG—8309) Forest residue wood chip substitution study. Phase 1.** (Neill and Gunter Ltd., Dartmouth, Nova Scotia (Canada); Atlantic Forestry Consultants, Antigonish, Nova Scotia (Canada)). 1983. 109p. (MICROLOG—88-05258). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The scope and intent of this study was to determine the viability of producing wood chip fuel from forest residue in Nova Scotia. The findings indicate that a large potential can exist for this industry if the proper approach to marketing and financing of conversion sites is taken. The 5-year average of forest production volume in Nova Scotia is 1000 kilotonnes/y of forest residue. This, added to silviculture operations, noncommercial stands, and other sources, raises the total to over 18,000 kilotonnes of biomass presently available, equivalent to 33 million bbl of oil. Results of a supplier survey indicate that 8 woodlot group ventures, 7 large landholders and 32 contractors are interested in the prospect of establishing a residue wood chip business. From consumer survey results, 22 of 253 sites indicated an interest in burning wood chips as fuel. Opportunity exists for growth, provided successful demonstration of the technology can be accomplished. Three consumers within 80 km of 3 producers have been identified in a specific viability study. It is anticipated that delivered product prices will vary from $30 to $65 per green tonne at 44% moisture content. At least 3 consumers for menu producer will be required to make a chip production business financially successful. This will only be possible through a series of events including successful chip production, successful demonstration of chip handling and burning equipment, effective marketing, staple supply and pricing policy, and subsidies for the chip producer. 16 refs., 12 figs., 22 tabs.

7568 **(PB—88-246772/XAB) Multiresource inventories: woody biomass in Virginia. Forest Service research paper.** Cost, N.D. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). Jun 1988. 39p. (FSRP-SE—269). NTIS, PC A03/MF A01.

Virginia's 25.4 million acres of land area support 1.5 billion tons of woody biomass. Of this total, 93% is on timberland, 5% on reserved timberland and woodland areas, and 2% on nonforest areas. Over the next two decades, more than 9 million tons of woody biomass could be harvested annually from timberland without adversely affecting timber supplies.

# 13 HYDRO ENERGY

## 1301 Resources And Availability

*REFER ALSO TO CITATION(S) 9422*

7569 **(E/WSC—1987) Historical streamflow summary, Yukon and Northwest Territories, to 1986.** (Environment Canada, Ottawa, Ontario. Water Survey of Canada). 1987. 155p. (In English and French). (MICROLOG—88-03037). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean discharges, and annual extremes of discharge, for rivers in Yukon Territory and the Northwest Territories for which streamflow data to 1986 inclusive have been collected. Data are presented for the entire period of record, as far back as 1902 in the Yukon, when hydrometric surveys were concerned with navigation; regular hydrometric work began in 1944 by the Dominion Water and Power Bureau of the federal government. Current survey data are collected by the Water Survey of Canada in cooperation with the federal Department of Indian Affairs and Northern Development, and assisted by other public agencies and private organizations concerned with water resources. This document also contains descriptive information about gauging stations, such as location, drainage area, and whether the flow is natural or regulated. Data are arranged alphabetically by name of gauging station within each territory.

7570 **(E/WSC—1987) Historical streamflow summary, British Columbia, to 1986.** (Environment Canada, Ottawa, Ontario. Water Survey of Canada). 1987. 948p. (In English and French). (MICROLOG—88-03038). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean discharges, and annual extremes of discharge, for rivers in British Columbia for which streamflow data to 1986 inclusive have been collected. Data are presented for the entire period of record, as far back as 1911, when stream-measurement work was conducted primarily for irrigation-supply purposes; in 1913 hydrometric surveys were continued by the federal Dominion Water Power Branch. Current survey data are collected by the Water Survey of Canada in cooperation with the provincial government, and assisted by other public agencies and private organizations concerned with water resources. This document also contains descriptive information about gauging stations, such as location, drainage area, and whether the flow is natural or regulated. Data are arranged alphabetically by name of gauging station.

7571 **(E/WSC—1987) Historical streamflow summary, Quebec, to 1986.** (Environment Canada, Ottawa, Ontario. Water Survey of Canada). 1987. 485p. (In English and French). (MICROLOG—88-03039). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean discharges, and annual extremes of discharge, for rivers in Quebec for which streamflow data to 1986 inclusive have been collected. Data are presented for the entire period of record, as far back as 1906, when hydrometric surveys were carried out by the Quebec Department of Lands and Forests. In 1913, surveys were taken over by a Waterways Commission and later by federal agencies. Current survey data are collected mainly by the Quebec environment ministry, assisted by other public agencies and private organizations concerned with water resources, such as Hydro-Quebec. This document also contains descriptive information about gauging stations, such as location, drainage area, and whether the flow is natural or regulated. Data are arranged alphabetically by name of gauging station.

## 1303 Plant Design And Operation

7572 **(NYSERDA—88-8) Modular hydropower demonstration.** (New York State Energy Research and Development Authority, Albany (USA); Acres International Corp., Amherst, NY (USA)). Sep 1988. 110p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89004093/JAW.

The modular approach has been developed for the construction of small hydro projects in order to reduce the costs and to shorten procurement and construction schedules that occur when designs and equipment selection more applicable to large projects are used. The modular approach aims to maximize the use of "off-the-shelf" and readily available components. A key feature is the replacement of the conventional purpose-designed hydroelectric turbine by a pump used in reverse as a turbine with fixed blades and vanes. Other features are the use of siphon penstocks, induction generators, prefabricated structures, and automated control equipment. The New York State Energy Research and Development Authority contracted with Acres International Corporation to study two small hydro projects designed and built using the modular approach, and compare each one with an equivalent conventional design. Equipment procurement and installation costs, general

construction costs, and energy production were estimated. Economic analyses were prepared. Preliminary data on operation and maintenance was recorded. The methodology and results of the study are contained in this report. 18 figs., 20 tabs.

## 1305 Economics And Management

*REFER ALSO TO CITATION(S) 7911*

## 1306 Environmental Aspects

*REFER ALSO TO CITATION(S) 7904, 7905, 7906, 7908, 7909, 7910*

**7573 (AD-A—198985/4/XAB) Evaluation of release improvement techniques for J. Percy Priest reservoir. Final report.** Price, R.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Hydraulics Lab.). Aug 1988. 32p. (WES/MP/HL—88-6). NTIS, PC A03/MF A01.

The J. Percy Priest Water Reservoir Project has experienced problems with the water quality of hydropower releases. During the annual stratification season (approximately May to November), the hypolimnion becomes devoid of oxygen creating a chemically reduced environment in which iron, manganese, and hydrogen sulfide become soluble. Upon hydropower generation, the oxidation of hydrogen sulfide creates a 'rotten egg' smell downstream. The methodology selected for improving the quality of the release was to install a localized mixing system in the reservoir in front of the hydropower intakes. The purpose of this report is to document results of field tests and the validity of the original design formulas (Holland 1984), and to better determine the number and location of pumps required to meet the desired release DO of 5.0 mg/1.

**7574 (DOE/BP/34796—4) Predation by resident fish on juvenile salmonids in John Day Reservoir: Final report, 1983-1986: Volume 1, Final report of research.** Poe, T.P.; Rieman, B.E. (eds.). (Fish and Wildlife Service, Cook, WA (USA); Oregon Dept. of Fish and Wildlife, Clackamas, OR (USA)). Nov 1988. Contract AI79-82BP34796;AI79-82BP35097. 384p. NTIS, PC A17/MF A01 - OSTI. Order Number DE89004407/JAW.

In 1982 the NPPC included in its Fish and Wildlife Program a measure that called for studies "... to investigate juvenile salmon and steelhead losses to predators while these fish are migrating through Columbia and Snake River reservoirs." In the same year the Bonneville Power Administration (BPA) funded ODFW and FWS to conduct collaborative studies to estimate the number of juvenile salmonids lost to predators in John Day Reservoir. Also included as study objectives were: (1) a description of the importance of predation losses relative to mortality at the dam and total reservoir mortality; (2) a description of how predation losses might vary (spatially and temporally); and (3) recommendations of measures to control predation on smolts. We studied four species of predator: northern squawfish, walleye, smallmouth bass, and channel catfish. We selected John Day Reservoir as the study site because the following factors led us to believe if predation was a problem in any reservoir, it would be most obvious there because: (1) the reservoir is an important subyearling chinook rearing area; (2) passage and residualism of juvenile salmonids were considered a problem there; and (3) substantial populations of predators were known to reside in the reservoir. Individual reports were processed separately for the data base.

**7575 (DOE/BP/34796—5) Predation by resident fish on juvenile salmonids in John Day Reservoir, 1983-1986: Volume 2: Supplemental papers and data documentation: Final report.** Poe, T.P.; Rieman, B.E. (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife; Fish and Wildlife Service, Cook, WA (USA); Oregon Dept. of Fish and Wildlife, Clackamas, OR (USA)). Jul 1988. Contract AI79-82BP34796;AI79-82BP35097. 194p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004406/JAW.

In 1982 the NPPC included in its Fish and Wildlife Program measure that called for studies "... to investigate juvenile salmon and steelhead losses to predators while these fish are migrating through Columbia and Snake River reservoirs." In the same year the Bonneville Power Administration (BPA) funded ODFW and FWS to conduct collaborative studies to estimate the number of juvenile salmoids lost to predators in John Day Reservoir. Also included as study objectives were: (1) a description of the importance of predation losses relative to mortality at the dam and total reservoir mortality; (2) a description of how predation losses might vary (spatially and temporally); and (3) recommendations of measures to control predation on smolts. We studied four species of predator; northern squawfish, walleye, smallmouth bass, and channel catfish. We selected John Day Reservoir as the study site because the following factors led us to believe if predation was a problem in any reservoir, it would be most obvious there because: (1) the reservoir is an important subyearling chinook rearing area; (2) passage and residualism of juvenile salmonids were considered a problem there; and (3) substantial populations of predators were known to reside in the reservoir. Individual reports were processed separately for the data base.

**7576 (DOE/BP/36154—1) Albeni Falls wildlife protection, mitigation, and enhancement plan: Final report, 1987.** Martin, R.C.; Hansen, H.J.; Meuleman, G.A. (Idaho Dept. of Fish and Game, Boise (USA)). Nov 1988. Contract AI79-87BP36154. 131p. NTIS, PC A07/MF A01 - OSTI. Order Number TI89004088/JAW.

A wildlife impact assessment and mitigation plan has been developed for the US Army Corps of Engineers Albeni Falls Project in northern Idaho. The Habitat Evaluation Procedure (HEP) was used to evaluate pre- and post-construction habitat conditions at the Albeni Falls Project. There were 6617 acres of wetlands converted to open water due to development and operation of the project. Eight evaluation species were selected with impacts expressed in numbers of Habitat Units (HU's). For a given species, one HU is equivalent to one acre of prime habitat. The Albeni Falls Project resulted in estimated losses of 5985 mallard HU's, 4699 Canada goose HU's, 3379 redhead HU's, 4508 breeding bald eagle HU's, 4365 wintering bald eagle HU's, 2286 black-capped chickadee HU's, 1680 white-tailed deer HU's, and 1756 muskrat HU's. The yellow warbler gained 71 HU's. Therefore, total target species estimated impacts were 28,587 HU's. Impacts on peregrine falcons were not quantified in terms of HU's. Projects have been proposed by an interagency team of biologists to mitigate the impacts of Albeni Falls on wildlife. The HEP was used to estimate benefits of proposed mitigation projects to target species. Through a series of proposed protection and enhancement actions, the mitigation plan will provide benefits of an estimated 28,590 target species HU's to mitigate Albeni Falls wildlife habitat values lost. 52 refs., 9 figs., 14 tabs.

**7577 (DOE/BP/39830—2) Lower Flathead System Fisheries Study: Main river and tributaries, Volume 2: Final report, FY 1983--1987.** DosSantos, J.M.; Darling, J.E.; Cross, D. (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife; Confederated Salish and Kootenai Tribes, Pablo, MT (USA)). Nov 1988. Contract AI79-83BP39830. 236p. NTIS, PC A11/MF A01 - OSTI. Order Number DE89004409/JAW.

We believe our results have clearly shown Kerr hydroelectric operations and operational constraints have negatively affected Flathead River trout and northern pike populations and the aquatic habitat which support them. Even so, it is possible to mitigate many of these impacts and develop a very important fishery. Trout abundance in the lower Flathead averaged only 19 fish per kilometer, the lowest abundance of trout for a river of this size in Montana. Little main channel spawning by trout was observed and most spawning probably occurs in tributaries. Lower river tributaries support resident populations of brook, rainbow, brown, and cutthroat trout; and a small resident population of bull trout is present in the South Fork of the Jocko River. Using weirs, spawning runs of rainbow and brown trout from the main river were monitored entering the Jocko River and the Post/Mission Creek system. Utilization of Crow Creek by main river trout stocks of trout was limited to the 6 km segment below Crow Dam. Evaluations of tributary spawning gravels showed high levels of silt which would suggest poor survival of trout eggs. Excessive harvest in the tributaries was

indicated by analysis of age class structure and abundance of trout greater than 200 mm.

7578 **(DOE/BP/39830—T1) Lower Flathead System Fisheries Study: Executive summary, Volume 1: Final report FY 1983--1987.** Cross, D.; DosSantos, J.M. (Confederated Salish and Kootenai Tribes, Pablo, MT (USA)). Jun 1988. Contract AI79-83BP39830. 55p. NTIS, PC A04/MF A01 - OSTI. Order Number TI89004086/JAW.

This Executive Summary, Volume I, of the lower Flathead System Fisheries Study Final Report, was prepared to provide a study overview for persons who are not fisheries scientists. The contents provide an introduction to the study and its objectives, a short description of the study area, a discussion of the major findings and conclusions of the study, and the description of fisheries management alternatives available to managers of the lower Flathead system. Technical reports were prepared for those portions of the study dealing with the lower Flathead River and its tributaries, Volume II, and the South Bay of Flathead Lake, Volume III. The annual hydrographic regime of the Flathead system, consisting of upper rivers, lake and lower river, has been modified by the construction and operation of two major hydroelectric facilities, Hungry Horse Dam on the south fork Flathead River and Kerr Dam at the outlet of Flathead Lake. The modified hydrographic regime has resulted in significant impacts to kokanee (Oncorhynchus nerka) and several species of trout. Kerr Dam, closed in 1938, controls Flathead Lake levels between 878.7 m (2883 ft) and 881.8 m (2893 ft) and discharges into the lower Flathead River. Kerr Dam is a 63.4 m (208 ft) high concrete arch structure located 7.2 km (4.5 miles) downstream from the outlet of Flathead Lake. The facility is used by Montana Power Company primarily for system frequency load control with some use for low level base load. 77 refs., 5 figs.

7579 **(DOE/BP/60790—1) Effects of the Cabinet Gorge Kokanee Hatchery on wintering bald eagles in the lower Clark Fork River and Lake Pend, Oreille, Idaho: Final report.** Crenshaw, J.G. (Idaho Dept. of Fish and Game, Boise (USA)). Dec 1987. Contract AI79-86BP60790. 108p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004065/JAW.

The abundance and distribution of bald eagles (Haliaeetus leucocephalus) on the lower Clark Fork River, Lake Pend Oreille, and the upper Pend Oreille River, Idaho, were documented during the winters of 1985--86 and 1986--87. Peak counts of bald eagles in weekly aerial censuses were higher in 1985--86 (274) and 1986--87 (429) than previously recorded in mid-winter surveys. Differences in eagle distribution within and between years were apparently responses to changes in prey availability. Eight bald eagles were captured and equipped with radio transmitters in the winter and spring of 1986. Residencies within the study area averaged 13.9 days in 1985--86 and 58.3 days for the four eagles that returned in 1986-87. The eagles exhibited considerable daily movement throughout the study area. After departing the area, one eagle was later sighted approximately 1185 km to the southwest in northern California. Eagle behavioral activity was recorded at time budget sessions at areas of heavy use. Perching in live trees was the most common behavior observed. 34 refs., 39 figs., 17 tabs.

7580 **(DOE/BP/62251—1) Umatilla hatchery final predesign report.** (Corps of Engineers, Walla Walla, WA (USA). Engineering Div.). Apr 1988. Contract AI79-86BP62251. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004411/JAW.

This report provides information on the preliminary design of Umatilla Fish Hatchery near Irrigon, Oregon. The fish hatchery will be capable of rearing steelhead and chinook with an initial capacity of 290,000 pounds. Future expansion will allow for a total capacity of 500,000 pounds if the initial production goals are met. The hatchery will consist of both Oregon and Michigan style ponds. The Oregon ponds are similar to those at Irrigon. The Michigan ponds are more narrow and shallow, are self cleaning, and use oxygen supplementation to obtain higher rearing densities as is currently being done in the state of Michigan. The Oregon ponds are a two-pass system with the capability to convert to Michigan style ponds, if this mode of operation proves to be an effective method in the west. The Michigan ponds are three-pass with the capability to expand to four-pass.

7581 **(DOE/BP/65903—1) State of Idaho augmented anadromous fish health monitoring: Annual report, FY 1987.** Foott, J.S.; Hauck, A.K. (Idaho Dept. of Fish and Game, Boise (USA). Eagle Fish Health Lab.). Nov 1988. Contract AI79-87BP65903. 36p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004412/JAW.

The anadromous fish health monitoring program began in full operation in January 1988 after the hiring of the lead pathologist. This short operating period limits the amount of information available at the time of this writing. Pre-release sampling of smolts revealed the presence of several sub-clinical pathogens. Organosomatic analysis results demonstrated no major abnormalities in the examined stocks. The results of the 1988 steelhead broodstock sampling are still pending.

7582 **(ORNL/TM—10953) Simulation modeling of hydropower impacts on dissolved oxygen in the upper Ohio river basin.** Railsback, S.F.; Jager, H.I. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 135p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004301/JAW.

A model has been developed to assess the impacts of hydropower development at navigation dams on dissolved oxygen (DO) concentrations in the upper Ohio River basin. Field data were used to fit statistical models of aeration at each dam. The Streeter-Phelps equations were used to model DO concentrations between dams. Input data sources were compiled, and the design conditions used for assessment of hydropower impacts were developed. The model was implemented both as Lotus 1-2-3 spreadsheets and as a FORTRAN program. This report contains users' guides for both of these implementations. The sensitivities and uncertainty of the model were analyzed. Modeled DO concentrations are sensitive to water temperature and flow rates, and sensitivities to dam aeration are relatively high in reaches where dam aeration rates are high. Uncertainty in the model was low in reaches dominated by dam aeration and higher in reaches with low dam aeration rates. The 95% confidence intervals for the model range from about {+-} 0.5 mg/L to about {+-} 1.5 mg/L.

### 1307 Power-conversion Systems

*REFER ALSO TO CITATION(S) 7572*

## 14 SOLAR ENERGY

### 1401 Resources And Availability

*REFER ALSO TO CITATION(S) 9278*

7583 **(AD-A—198550/6/XAB) Daylight and twilight sky radiance and terrestrial irradiance. Technical report.** Waldman, C.H. (Titan Systems, Inc., La Jolla, CA (USA)). Jan 1988. 25p. NTIS, PC A03/MF A01.

When solar radiation is transmitted through the atmosphere it may be reflected, transmitted, or absorbed. The total effect of the atmosphere upon a beam of sunlight passing through it is to reduce its intensity by amounts varying with latitude, season, and degree of cloudiness. The atmosphere weakens solar energy through (1) molecular and small-particle scattering, (2) diffuse reflection by larger particles, and (3) selective absorption as due to ozone and water vapor. The scattering and reflecting processes send a part of the solar energy back into space, but some of it reaches the earth's surface as diffuse sunlight. A model for the sky radiance and terrestrial irradiance is developed, and a computer program was written to carry out the calculation.

7584 **(PB—88-252424/XAB) Microclimatic variations in solar radiation near Austin, Texas.** Vliet, G.C.; Guthrie, T.; Mickalonis, M. (Texas Univ., Austin (USA). Center for Energy Studies). Aug 1987. 43p. (CONSERV-SOLAR-RR—4). NTIS, PC A03/MF A01.

When the study began (September 1984), the City of Austin (Texas) had plans to install a 300-kW photovoltaic power unit as part of its power-generation system. The city was interested in a number of factors that might affect the performance of the new unit, one of these being its location. Since then, the photovolatic system was installed and put into operation. Because Austin lies along the Balcones Escarpment, which is known to cause major weather effects in the region, the city funded a project to monitor solar radiation at five sites within an approximate 30-mile radius of the city. The monitoring study extended over a one-year period, January 1985 through January 1986.

## 1405 Solar Energy Conversion

*REFER ALSO TO CITATION(S) 7250, 7495, 7523, 7537, 7542, 7543, 7553, 7554, 7562, 7564, 7565, 7566, 7567, 7622, 7961, 8553, 9303, 9308, 9309, 9310, 9436, 9449, 9530, 9531, 9532, 9534, 9540, 9583, 9584, 9585*

7585 **(AD-A—198533/2/XAB) Rugged, thin GaAs solar cell development. Interim report, November 1985-June 1987.** Wagner, K. (Applied Solar Energy Corp., City of Industry, CA (USA)). May 1988. 50p. NTIS, PC A03/MF A01.

This report describes the phase II efforts in developing high-efficiency GaAs-ON-Ge solar cells for enhanced survivability, ruggedness, and reduced weight over conventional devices. This work emphasizes efforts to improve the cell performance from phase I, initial testing of the cells, and fabrication of a module for space-flight testing. The specific goals for the program are: An Air Mass Zero (AM0) conversion efficiency of 18% for beginning-of-life (BOL) at 27 + or - 2 C; An AM0 conversion efficiency of 13.5% at 27 + or - 2 C after exposure to 5 x $10^{15}$ (MeV) electrons/sq.cm.; A cell weight not to exceed 0.05 grams per square centimeter of cell area.

7586 **(ADR—P-152) Biomass production from the harvesting of a tolerant hardwood stand in Algoma, Ontario.** Cameron, D.A. (Anstress (D.R.), Sault St. Marie, Ontario (Canada)). [1981]. Vp. (CE—02095). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An 11 hectare harvesting operation was conducted in an overmature tolerant hardwood stand typical of forests in the Algoma region of Ontario. Along with a control, five intensities of a chipping operation were integrated with a conventional sawlog operation. The intensities were: clearcut to two diameter limits, shelterwood cut to a diameter limit, shelterwood cut for sawlogs with chipping of the unutilized portions, and cleanup of a previously harvested strip. Biomass cruises before and after harvesting were compared with measured miomasss removal to check the accuracy of the estimate. The estimate was based on a biomass inventory conducted in 1987 and 1979 in similar stands in the area. Records were maintained of times, costs and revenues for all work done on the individual 1.02 hectare plots, and are presented in this report. Energy equivalents and prices for alternative fuels suggest that the present prices ($8.82/green tonnne) grossly undervalue the chips for energy use and do not justify an integrated harvesting at today's rates. 9 refs., 2 figs., 20 tabs.

7587 **(CONF-8809181—1) PAR [photosynthetically active radiation] conversion efficiencies of a tropical rain forest.** Luxmoore, R.J.; Saldarriaga, J.G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002332/JAW.

From International symposium on forest tree physiology; Nancy, France (25 Sep 1988).

The mean annual quantities of photosynthetically active radiation (PAR) absorbed during various stage of regeneration of a tropical rain forest in the upper Rio Negro region of Colombia and Venezuela were estimated for the intervals between clearcut and 1, 3, 10, 20, 35, 60, 80, and 200 years of growth. The forest phytomass and litterfall at each storage were from previous studies, and the data were used to calculate the mean annual quantity of net dry matter production per unit of absorbed PAR, the PAR conversion efficiency. 7 refs., 2 figs., 1 tab.

7588 **(CRIE-U—87048) Production of ethanol, fat and oil and methane gas from several crops.** Uehara, Tsuyoshi; Suganuma, Hirotoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 29p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Aiming at production of ethanol, fat and oil and so on, ten kinds of miscellaneous cereal crops such as pearl-millet, soybean and so on were grown, and comparative investigation of the production rate which was considered utilization of whole plants were carried out. The suitability of vegetable wastes as methane fermentation materials for the methane gas production was investigated by the constituent analyses and methane fermentation experiments. Nine kinds of the grasses and vegetable wastes such as tomatoe buds, broccoli leaves were used for the investigation. As the results, the estimated yield of ethanol per 10 are from pearl-millet was 690 liter, the estimated yield of fat and oil per 10 are was 70 liter from soybean, The results of the analyses of nine kinds of the farm residues were as follows: (1) carbon content of about 40 %, (2) C/N ratio of 13 av., (3) C/P ratio of 91 av., and (4) the content of C,N and P was roughly appropriate. 680 to 760 milliliter of methane gas was produced from one gram of the dry matter of tomatoe bods, and in case of broccoli leaves, 424 milliliter of methane gas was produced, it was found that these values were not inferior to animal dung. (4 figs, 15 tabs, 6 refs)

7589 **(CRIE-U—87056) Preliminary study for creation of kelp forest(part 1). Seasonal changes of lamina and growth of root of eisenia bicyclis in Odawa bay, Miura peninsula.** Terawaki, Toshinobu; Goto, Hiroshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1988. 24p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo. Order Number DE88755724/JAW.

Preliminary study for creation of kelp forest has been carried in Odawa bay, Kanagawa Prefecture. In foreshore reclamation in electric power plant siting, the restoration and substitute measures of kelp forest have become important for the protection of living aquatic resources and marine environment, it is an urgent need to develop artificial creation of kelp forest. Observations on seasonal changes of lamina and growth of root of Eisenia bicyclis were carried out during July 1984 to October 1985. The maximum weight of lamina reached about 600g during July to August, then it decreased and became minimum weight of 120g in November. Maturation period were observed during September to next March. Primary pinnae length reached maximum of 57cm during March to April and became minimum of 30cm in October. It's width reached maximum of 9cm in July and became minimum of 6cm in November. Growth of new root occured in October, it reached rock-bed exceeding old root in next April. New root weight occupied 40% of whole holdfast weight. Duration of November to February, in which maturation and growth of root are active, is important season for the preservation of Eisenia bicyclis population, and is suitable for seeding and transplanting. (14 figs, 2 tabs, 15 refs)

7590 **(DOE/ER/13621—2) Transcriptional analysis of the R locus: Progress report, November 1987 through October 1988.** Wessler, S.R. (Georgia Univ., Athens (USA). Dept. of Botany). Nov 1988. Contract FG09-86ER13621. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004364/JAW.

Previous studies resulted in the isolation of genomic clones containing parts of the R locus from a number of alleles. In addition, preliminary results suggested that all R alleles analyzed encoded a rare 2.6 kb mRNA that was present in some pigmented tissue but not in unpigmented tissues. Genetic and molecular analysis appear to be consistent with the hypothesis that all R alleles encode an identical gene product; allelic diversity reflects distinctive organ and/or tissue specific patterns of expression. It is con-

ceivable that R alleles may only differ in their promoter and untranslated regions. Although we do not know what the R protein does, we believe that it may be the limiting factor in anthocyanin biosynthesis when either light or the products of either Cl or Pl are also present (along with wild-type A, A2, C2, Pr, Bz, Bz2). In this way, a slight change in the temporal or organ specific pattern of R gene expression will be easily identified as a new R allele. Our experiments over the past year and our proposed research are designed to elucidate the function of the R protein, determine the structure of the Lc transcription unit and test the hypothesis mentioned above.

7591 **(ESA-CR(P)—2581) Alternative module configurations for advanced solar arrays on low orbit and extended lifetime missions (AMOC 2). Final report.** Gringel, D.; Hoffmann, U.; Koch, J.; Reissmann, F.; Schmitz, W. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Wedel (Germany, F.R.)). Dec 1987. 116p. (ETN—88-93026). NTIS, PC A06/MF A01.

The applicability of the bifacial solar cell for generators operating in the low earth orbit and having extended life time mission was studied. Two candidate module concepts for flexible roll out and/or fold out solar generator systems were defined. One module concept is characterized by a continuous light transparent substrate and uses a transparent adhesive to glue the solar cells onto the substrate. The other module concept uses a nontransparent substrate with cutouts (windows) in the solar cell area of the substrate so that only small rearside areas of the individual solar cells are covered. The design and the bifacial solar cell technology were improved with regard to their applicability for larger assemblies. A thermal vacuum cycling test on a foldable ATOX resistant window type solar panel assembly confirms design feasibility.

7592 **(JKCA—1981) A review of energy requiremenets to comminute woody biomass.** Jones, K.C. (Jones (K.C.) and Associates Ltd., Ottawa, Ontario (Canada)). 1981. 45p. (CE—02119). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report compares in graphical and tabular form the energy required to comminute woody materials into various nominal size particles. A rather theoretical approach is taken to emphasize that the objective of comminution for energy conversion is to produce a surface area, rather than the traditional objective of improving materials handling properties. Without clearly recognizing this difference, the development of energy saving techniques will be kept at a minimal pace and stifled by the preponderance of well developed traditional comminution and materials handling systems. The energy requirements presented are independent of materials handling effects, having been drawn primarily from laboratory test results, presented in terms of the oven dry productivity of the mechanisms. In a general sense this review shows that to reduce energy requirements harvesting residues should be comminuted after drying below the Fiber Saturation Point, particularly when impact machines are considered. Impact machines such as slash cutters can be used to produce large size particles, 15 cm nominal, for roughly the same energy requirement as chippers producing 2.5 cm particles. The involuted disc chipper and spiral head chipper are able to produce 7.5 cm particles for 1/3 the energy requirement of pulp chippers. However, they are presently limited to processing material with a diameter less than 15 cm. Roll crushing is a promising technique for preparing long silver-like particles from roundwood and slash. Baling of residues has the greatest potential for reducing energy requirements. Complicating indicate that shearing and compacting residues in one cubic metre bales requires roughly one quarter of the energy needed to make it into 2.5 cm long pulp chips. 27 refs., 24 figs., 5 tabs.

7593 **(JKCA—1981) Field tests to develop energy saving wood comminution techniques.** Jones, K.C. (Jones (K.C.) and Associates Ltd., Ottawa, Ontario (Canada)). 1981. 114p. (CE—02118). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes four separate projects carried out on various energy-saving techniques for preparing fuel stocks from harvesting residues. The Fling Solid Waste Demolisher (SWD), which uses the kinetic energy of free-swinging hammers to comminute material, was tested as it processed logging sortyard debris. A portable knife hog was also tested, processing hardwood slash. Results indicate SWD's requirements are high compared to a chipper, and that it is relatively immune to damage from tramp steel and stones. The knife hog's performance had poor results compared to more mechanized systems. Both machines' productivity and energy efficiency are most seriously limited by the inability of linear infeed systems to maintain a capacity load. A roll splitting mechanism, using a double roll crusher that also squeezed water from the wood, was examined as an alternative to chippers or hammermills. Lab tests determined the energy requirements of comminuting roundwood into a loose mat of slivers. Energy requirements of this dewatering function were compared to thermal drying energy requirements. Finally, tests were carried out to bale rolled crushed slash and roundwood, in order to determine whether this process could be used to preprocess, dewater and infeed material to a baler. The energy requirements to roll crush slash are presented, as are the solid volume 0actors and bulk densities achieved by baling crushed wood. A steam generator to burn whole bales is also proposed. 43 refs., 47 figs., 17 tabs.

7594 (KFK-PEF—35-Vol.1, pp 75-83) **Patterns of reaction of vegetation on fertilisation stands in Northern Black Forest.** Schornick, O. (Freiburg Univ. (Germany, F.R.). Inst. fuer Landespflege). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

On experimental fertilization areas of the 'Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg' the results of a 20-30 year old succession after fertilization have been analysed. The alteration of vegetation is described in fertilization-reaction-patterns, which take in consideration changes within combination of species, cover-abundance, sociability and the height of the layers. The vegetation of the unfertilized fields is characterized by small quantity of species and low development of height. On the fertilized stands the different patterns are discribed.

7595 (KFK-PEF—35-Vol.1, pp 151-161) **Examples of plant physiological research on trees in relation to forest decline in the Federal Republic of Germany.** Eschrich, W. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstbotanik). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Six examples of current research on the physiology of beech trees (Fagus sylvatica) are given, and arising questions are discussed: A) the impact light has on shade leaves after irregular shelterwood felling; B) the natural dying-back of low branches; C) the analysis of twig girdling at different periods prior to bud burst; D) the initiation and possible origin of spring sap; E) the differences between beeches with early and with late bud burst; F) the processes leading to elimination of waste material or surplus ions. It is concluded that basic research in three physiology requires the inclusion of the tree age into the research program.

7596 (KFK-PEF—35-Vol.1, pp 173-183) **Physiological and biochemical studies on the yellowing of spruce trees in higher altitudes. Pt. 1. Protection of pigments in the light-harvesting Chl-a/b-protein against photooxidation - the role of apoprotein and pigment organisation.** Siefermanns-Harms, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The light-harvesting Chl-a/b-protein complex (LHC) from Spinacea oleracia, Lactuca sativa and Picea abies is stable under strong white light (> 350 nm, 1000 w/m/sub 2/). Therefore, LHC preparations were used to examine requirements for the protection of LHC-bound pigments from photooxidation. - The presence of carotenoids in the LHC and their arrangement in close proximity with the chlorophylls are not sufficient for pigment protection under light. - An intact LHC apoprotein is required to protect the pigments from photooxidation. Evidently, the intact LHC apoprotein represents a barrier for O/sub 2/ limiting O/sub 2/ access to the microenvironment of the pigments. - The composition of the pigment fraction destroyed under light depends on the state of the LHC. If only the integrity of the apoprotein is impaired, both, chlorophylls and carotenoids are subjected to photooxidation.

7597 (KFK-PEF—35-Vol.1, pp 371-381) **Some results on spruce growth in present and former times.** Kenk, G.; Spiecker, H. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The project 'Reference-data to forest growth' compares growth of actual and preceding stands generations on permanent research plots. Differences between recent and past growth pattern show extent and direction of possible changes. On the Norway spruce research plots increment varies periodically considerably. During recent years increment in height, diameter and volume per ha increasaed slightly. Height growth of the actual spruce stand compared with the preceding stand is on a remarkable higher level.

7598 (N—88-28942) **Lewis Research Center space station electric power system test facilities.** Birchenough, A.G.; Martin, D.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1988. 30p. (NASA-TM—100924; E—3904; NAS—1.15:100924). NTIS, PC A03/MF A01.

NASA Lewis Research Center facilities were developed to support testing of the Space Station Electric Power System. The capabilities and plans for these facilities are described. The three facilities which are required in the Phase C/D testing, the Power Systems Facility, the Space Power Facility, and the EPS Simulation Lab, are described in detail. The responsibilities of NASA Lewis and outside groups in conducting tests are also discussed.

7599 (N—88-30181) **Advanced planar array development for space station. Final report, 1 June 1985-1 June 1987.** (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). Jun 1987. 101p. (NASA-CR—179373; NAS—1.26:179373; LMSC-F—115808). NTIS, PC A05/MF A01.

The results of the Advanced Planar Array Development for the Space Station contract are presented. The original objectives of the contract were: (1) to develop a process for manufacturing superstrate assemblies, (2) to demonstrate superstrate technology through fabrication and test, (3) to develop and analyze a preliminary solar array wing design, and (4) to fabricate a wing segment based on wing design. The primary tasks completed were designing test modules, fabricating, and testing them. LMSC performed three tasks which included thermal cycle testing for 2000 thermal cycles, thermal balance testing at the Boeing Environmental Test Lab in Kent, Washington, and acceptance testing a 15 ft x 50 in panel segment for 100 thermal cycles. The surperstrate modules performed well during both thermal cycle testing and thermal balance testing. The successful completion of these tests demonstrate the technical feasibility of a solar array power system utilizing superstrate technology. This final report describes the major elements of this contract including the manufacturing process used to fabricate modules, the tests performed, and the results and conclusions of the tests.

7600 (N—89-10407) **Advanced planar array development for space station. Final report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). May 1987. 68p. (NASA-CR—179372; NAS—1.26:179372). NTIS, PC A04/MF A01.

The objectives are to develop a process for manufacturing superstrate assemblies; demonstrate superstrate technology through fabrication and testing; develop and analyze a preliminary solar array wing design; and fabricate a wing segment based on the wing design. The task description, project flow diagram, and schedule are outlined. The progress to date is presented.

7601 (NFRC—N-X-199) **Biomass equations for six tree species in central Newfoundland.** Lavigne, M.B.; van Nostrand, R.S. (Newfoundland Forest Research Centre, St. John's (Canada)). 1981. 56p. (CE—02098). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The development of tree biomass equations is a necessary part of a program of research and development designed to determine the potential of the Newfoundland forest resource as a source of energy. The equations can be used with available inventory data to estimate standing crop of biomass, and are necessary for evaluating forest management practices. This report describes the first work in the province to produce reliable biomass prediction equations. Data were collected for the six major tree species in central Newfoundland: black spruce, white spruce, balsam fir, larch, white birch and trembling aspen. Biomass tables for oven-dried mass of above-ground components and the whole tree were constructed using regression analyses. Five regression models were tested for predicting biomass. The model providing the best fit to data and having statisfactory statistical properties, was a weighted regression using the product or the height and the square of the breast height diameter as the independent variable. The sum of predicted masses of components equals the predicted total mass for any combination of breast-high diameter and height. 10 refs., 26 tabs.

7602 (NP—9770154) **Photovoltaics - a research priority in the exploitation of solar energy.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 23 Nov 1987. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770154/JAW.

Emanating from a short survey of 10 years of photovoltaic promotion (scientific initial phase, industrial development, today's aims: reduction of production costs, intensification of efficiency, improved system and utilization technology), the report is concerned with basic materials, cells and modules (crystalline silicon, amorphous thin-layers) and with the utilization-orientated fundamental research (new solar priorities, electricity recovery) and system technology. To this belong photovoltaic small apparatus and installation technology (non-network supply tasks, projects of the German electricity economy, combination with wind plants). In conclusion, it is emphasized that photovoltaic, technologically speaking, remains with high promotion priority in the energy research programme. (HWJ).

7603 (NSRFC—8712) **Cellulase from the white-rot fungus Polyporus anceps.** Reade, A.E. (Nova Scotia Research Foundation Corporation, Dartmouth (Canada)). 1987. 64p. (MICROLOG—88-06247). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study was undertaken to assess the cellulolytic potential of Polyporus anceps by comparing it to Trichoderma reesei RUT-C30. The activities of the various components of the cellulase complex were monitored in culture filtrates from submerged fermentations of the two fungi growing on purified cellulose or milled poplar. Compared to T. reesei, on neither substrate was P. anceps superior. Filtrates from both fungi showed similar activities against carboxymethylcellulose and salicin when the growth substrate was purified cellulose, but with P. anceps, the Avicel and filter paper activities were poor. When the fungi were grown on milled poplar, T. reesi filtrates showed more activity against filter paper, carboxymethylcellulose and xylan than did P. anceps filtrates. Filtrates produced by T. reesei grown on poplar had similar filter paper, carboxymethylcellulose and xylan degrading activities to those produced by T. reesei grown on cellulose. Tests of the hydrolytic po-

tential of culture filtrates from the two fungi supported the measurement of enzyme activities. T. reesei filtrates were superior in the release of sugars from filter paper, Solka Floc and milled poplar at all times during a 72 h incubation period. It was concluded that when compared in submerged culture experiments, this strain of P. anceps was inferior to T. reesei (RUT-C30) in its ability to produce cellulase. As a result, P. anceps is unlikely to be a serious competitor to T. reesei without undergoing the extensive selection process which has produced this strain of T. reesei. 39 refs., 18 figs., 2 tabs.

7604 **(PB—89-126494/XAB) Solar-fuel synthesis based on colloidal and particulate semiconductors. Annual report, August 1, 1987-July 31, 1988.** Frank, A.J.; Graetzel, M. (Solar Energy Research Inst., Golden, CO (USA)). 15 Aug 1988. 76p. NTIS, PC A05/MF A01.

See also PB—88-112461.

The properties of a new and very active oxygen-evolving dimeric complex L2(H2O)Ru-O-Ru(H2O))L2 (where L = 2,2′-bipyridyl-4,4′-dicarboxylate) were scrutinized. Stable and very reactive H2-evolving photosystems based on the linear-chain complex (Pt(bpy)2)(Pt(CN)4) were characterized. The scale-up of one photosystem produced significant quantities of gas. The pathway of room temperature methanation of CO2 on TiO2-supported mixed Ru/RuO2 catalyst was studied by FTIR spectroscopy. The same material was found to enhance drastically the Boudard disproportionation and the conversion of NO and CO to CO2 and N2O. A MoO3/TiO2 catalyst was discovered that displays high activity in the photoactivation of methane at 40 deg C. An efficient room temperature photocatalyst Pt(bpy)-TiO2 was also discovered for selectively oxidizing methanol to formaldehyde, a valuable chemical feedstock. An unprecedented light-to-current conversion efficiency of 91% was achieved in sensitizing fractal-type semiconductor oxide films. Regenerative photoelectrochemical cells based on Al-doped anatase films and the Br(1-)/Br2 redox couple were scaled up to 32 sq cm surface area. An open-circuit voltage of 1.05 V, a fill factor of 73% and a polychromatic light-to-power conversion efficiency of 3.5% were obtained with the system.

7605 **(PB—89111280/XAB) Study on silviculture techniques of fast-growing fuel-wood crops in tropical China. Technical report.** Zheng, H.; Cai, M.; He, K.; Lai, H. (Chinese Academy of Forestry, Guangzhou, GD. Inst. of Tropical Forestry). 1987. 8p. NTIS, PC E03/MF A01.

This paper is a primary report studying the silviculture techniques of fast-growing fuel-wood species for Acacia auriculiformis and Eucalyptus exserta under poor conditions. Four spacing treatments of 1.0 x 1.0 m, 1.0 x 1.5 m, 1.5 x 1.5 m and 1.5 x 2.0 m were adopted. The growth increments of diameter, height and biomass were determined. The changes of soil nutrients were observed also. The felling and regenerating trials began at 3 years after planting.

7606 **(SERI/STR—211-3226) High-efficiency copper ternary thin-film solar cells: Final subcontract report, 1 May 1985--28 February 1987.** Kapur, V.K.; Basol, B.M.; Tseng, E.S.; Kullberg, R.C.; Nguyen, N.L. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1988. Contract AC02-83CH10093. 51p. NTIS, PC A04 - OSTI. Order Number DE89000826/JAW.

This report contains research results on the fabrication of high-efficiency, thin-film solar cells with electroplated $CuInSe_2$ (CIS) films. A small-area solar cell was fabricated with a conversion efficiency of 10.4%, an open-circuit voltage of 455 mV, a short-circuit current density of 41.4 $mA/cm^2$, and a fill factor of 55.4%. These results indicate that high-efficiency CIS/CdS solar cells can be fabricated using electroplated CIS films. Special attention was paid to the effect of substrates on the quality of both the CIS films and the devices. A process was developed to prepare glass/Mo substrates by electron-beam (E-beam) evaporation instead of the more commonly used sputtering technique. Unlike the sputtered Mo/glass substrates, the E-beam-evaporated substrates were free of stresses and showed very good adhesion of the Mo layer to the glass. Selenization studies were carried out to understand time and temperature effects on the formation of various phases before single-phase CIS is formed in the electroplated films. 5 refs., 8 figs., 1 tab.

7607 **(SERI/STR—211-3376) Research on amorphous-silicon-based thin-film photovoltaic devices: Task B: Phase 1 semiannual subcontract report, 16 March 1987--30 September 1987.** Delahoy, A.E.; Eser, E.; Kampas, F. (Chronar Corp., Princeton, NJ (USA)). Aug 1988. Contract AC02-83CH10093. 49p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89000833/JAW.

Research activities for the first six months of this work on amorphous-silicon-based, thin-film photovoltaic devices are described. In semiconductor materials research, most of the initial work was conducted to improve various analytical capabilities. A thermally stimulated current technique was introduced to characterize a-Si:H solar cells. In nonsemiconductor materials research, activities concentrated on the stabilities of various interfaces in the solar cell. In the area of submodule research, detailed studies were performed on the relationship between the deposition parameters and solar cell characteristics and on the laser scribing technique used in patterning large modules. 7 refs., 17 figs., 2 tabs.

7608 **(SERI/STR—211-3415) Novel silane and disilane precursors to amorphous semiconductors: Final subcontract report, May 1988.** Pernisz, U.C.; Sharp, K.G. (Solar Energy Research Inst., Golden, CO (USA); Dow Corning Corp., Midland, MI (USA)). Sep 1988. Contract AC02-83CH10093. 63p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89000825/JAW.

This Final Report describes the preparation and characterization of amorphous fluorohydrogenated silicon thin films. The novel approach in this study lies in the use of fluorinated silanes as film precursors. The advantages of this method are well defined initial ratios of hydrogen and fluorine to silicon and greatly reduced hazards in the handling of the gas. Fluorine derivatives of both silane and disilane were synthesized. Both glow discharge (or plasma-enhanced CVD) and thermal (CVD) methods were employed to prepare amorphous silicon on glass and silicon wafers. The electrical characterization of the material prepared from difluorosilane showed that the a-Si:H:F films obtained are of solar-grade semiconductor quality and can be doped to p- and n-type materials with diborane and phosphine. 29 refs., 24 figs., 10 tabs.

7609 **(SERI/STR—211-3416) A high-efficiency, single-junction, back-surface GaAs concentrator solar cell: Final subcontract report, 1 May 1986--31 July 1987.** Timmons, M.L. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1988. Contract AC02-83CH10093. 40p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89000827/JAW.

This report covers the second year of a two-year research effort to develop back-surface, point-contact solar cells in the GaAs system for use in concentrators with up to 1000 suns illumination. In the first year, a modeling code for Si point-contact cells was applied to simulate the performance of a point-contact GaAs cell. The second-year goal was solved by using an electrochemical etching procedure borrowed from photocathode and LED technology. AlGaAs layers as thin as 2 micrometers have been removed intact from GaAs substrates in less than 2 hours. The means of forming the $n^+$ and $p^+$ regions of the point-contact structures was changed from ion implantation selective epitaxial regrowth, to permit a single metallization step. The mask set for placing contacts was improved to facilitate processing. The ability to fabricate cells that have the potential to reach 30% conversion efficiency now seems to be within reach. 9 refs., 16 figs.

7610 **Electron spin resonance of charge carriers in chlorophyll a/water micelles.** Bowman, M.K.; Michalski, T.J.; Tyson, R.L.; Worcester, D.L.; Katz, J.J. (Argonne National Lab., IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 5, 1498-1502(Mar 1988). Contract W-31-109-ENG-38.

Chlorophyll a/water micelles (P740) prepared in hydrocarbon media have been shown by small-angle neutron scattering to consist of hollow cylinders whose surface is formed of a monolayer of chlorophyll crosslinked by water. The micelles can be reversibly oxidized or reduced to generate highly mobile holes or electrons that undergo rapid, one-dimensional transport along the chains of chlorophyll macrocycles comprising the surface of the micelles.

Large $\pi$-$\pi$ overlap within the chains facilitates the one-dimensional charge transport and is expected to do the same for energy transport. Structural defects in the micelle surface act as boundaries for charge transport, confining the spins to one-dimensional domains of approximately 200 macrocycles. The one-dimensional transport within the limited domains results in motionally narrowed electron spin resonance lines with some residual inhomogeneous broadening. Although the chlorophyll a incorporated in micelles is more easily oxidized than is monomeric chlorophyll a, it is much more resistant to chemical alteration.

7611 **Tracking microorganisms and gene in the environment.** Atlas, R.M.; Sayler, G.S. (Univ. of Louisville, KY (USA)). pp 31-45 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Studies have been conducted to determine the sensitivities and limitations of various methods for determining the fate of genetically engineered microorganisms (GEMs) and their genes in the environment. Selective viable plate count procedures can be designed to detect the introduced organisms with high sensitivity; but they are restricted by potential mutations affecting the expression of the selective characteristic in the introduced organism, the occurrence of the particular selective characteristic in the indigenous organisms, and the need to culture the organism. The accuracy of this approach is greatly improved by colony hybridization procedures that use a specific gene probe to detect the introduced genes, but this approach is still only as sensitive as the plating procedure. Direct extraction of DNA from environmental samples, coupled with dot blot hybridization with radiolabeled probe DNA or solution hybridization, gives a high degree of both sensitivity and precision. This approach does not require culturing of the organism; and even if an introduced gene moves into a new organism or if the introduced organism is viable but nonculturable, the gene probe methods will detect the persistence of the introduced genes in the environment. Efficient direct DNA extraction methods have been developed and tested following in vitro experimental additions of GEMs to sediment and water samples.

7612 **Prospects for laboratory engineering of bacteria to degrade pollutants.** Timmis, K.N.; Rojo, F.; Ramos, J.L. (Univ. of Geneva (Switzerland)). pp 61-79 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

In this brief review, the authors will discuss the use of genetic manipulation strategies for the rational evolution of new catabolic phenotypes in soil bacteria. Experiments were described to restructure existing pathways by enzyme recruitment through gene cloning or by mutational alterations of protein specificities, so that the newly acquired proteins recognize new substrates/inducers/ In some cases, novel metabolic routes were created by the patchwork assembly of enzymes and regulators from different pathways and from different organisms. These experiments confirm that experimental evolution of metabolic pathways is feasible and hold considerable potential for accelerating the evolution of microbes that will be able to degrade particularly recalcitrant and toxic compounds. Although they have focused largely on the manipulation of genes of enzymes and regulators, it is evident that other targets for experimental intervention will become relevant in the near future.

7613 **Constructing microbial strains for degradation of halogenated aromatic hydrocarbons.** Chapman, P.J. (Univ. of Minnesota, St.Paul (USA)). pp 81-95 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Studies of the biodegradation of organic compounds have gained increased interest in the last few years as their relevance to environmental pollution and the treatment of chemical wastes has acquired a wider appreciation. This area of research, once described in some microbial physiology texts as peripheral metabolism, has become central to the author concerns about the persistence of noxious organic chemicals in the environment and to the development of rational biological approaches for their removal. Among those chemicals that prompt concern are a variety of halogenated hydrocarbons, of which the halogenated aromatic hydrocarbons represent a subcategory. In recent years it has been possible to isolate or construct in the laboratory bacteria capable of growth with some of the simpler members of this series of chemicals which have a reputation for both toxicity and persistence. This chapter will examine some of the methods that have been used to isolate and to construct bacteria capable of growing aerobically with chlorinated aromatic compounds, including hydrocarbons. They will also describe some recent work in this area of research.

7614 **Stable inheritance of bacterial plasmids: practical considerations in the release of organisms into the environment.** Cohen, S.K.; Miller, C.A.; Beaucage, S.; Biek, D.P. (Stanford Univ. School of Medicine, CA (USA)). pp 97-104 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Most current applications of biotechnology involve the use of genetic engineering for the production of biologically active proteins in cells grown in fermenters. When such products are made in bacterial cells, gene constructs that yield large quantities of the desired product are employed using multicopy bacterial plasmid replicons. The continuing presence in the cell of a plasmid carrying the desired genes commonly can be assured by the addition of a selectable gene to the plasmid replicon and by growth selection under selective conditions. This review of plasmid, partitioning is intended to point out that the plasmid stability is an important practical consideration in the genetic manipulation of microorganisms that are to be introduced into the environment. While the mechanisms that affect plasmid stability are still incompletely understood at the molecular level, the current state of knowledge allows manipulations that can achieve either the goal of stable inheritance or the goal of unstable inheritance, if desired. It is hoped that the next few years will lead to more information at the mechanistic level.

7615 **Using knowledge of virulence factors to select or design organisms with low risk of pathogenicity.** Falkow, S. (Stanford Univ., CA (USA)). pp 121-126 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Applying our knowledge of ecology, physiology, and genetics of microbes to the pollution cleanup changes of our society may require that microorganisms be deliberately released into the environment. Naturally, there are scientists, legislators, and laymen who view such an action with concern. Among their concerns are what the potential danger to human and animal health might be. Fortunately, a fair amount is known about the factors that are involved in microbial pathogenicity. Can we use this knowledge to design genetically engineered microorganisms (GEMs) destined for release into the environment to have a minimal impact on animal or plant health? How can we apply the lessons learned from the study of microbial pathogenicity to the concerns that have been voiced about the release of GEMs into the environment? One scenario that is often voiced is that some minor genetic change in a nonpathogenic microbe would result in the creation of a new pathogen. Pathogenicity is multigenic and not accidental. In addition, the study of the ways in which microorganisms bring about disease has led us to design microorganisms at the genetic level to behave in expected, rather than unexpected ways. Understanding biological mechanisms, and manipulating them in the most minimal way possible, is the key to reducing any risks associated with the release into the environment of genetically modified organisms. The release of GEMs is not to be taken lightly, but we need not unnecessarily fear doing so, either.

7616 **Bioengineering issues related to in situ remediation of contaminated soils and groundwater.** McCarty, P.L. (Stanford Univ., CA (USA)). pp 143-162 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

This chapter presents some of the engineering challenges in biological degradation of organic contaminants in surface soils and the subsurface environment. Extraction of contaminants from the subsurface is generally costly, slow, and difficult. This has led to an interest in using in situ techniques for biodegradation of contaminants. For some contaminants that can be readily used a primary energy sources for bacteria with or without the presence of oxygen, occurs naturally. In other cases, such as hydrocarbon spills, in situ treatment is still attractive, but has the added cost and difficulty of supplying required oxygen and nutrients for the fairly efficient aerobic oxidation. There are some indications that hydrocarbons may be biodegraded in the absence of oxygen; but, in these cases, the rates of degradation appear to be slow. The major challenge lies in the decomposition of hazardous chemicals that appear to be transformed by the process of co-metabolism, or else are so low in concentration that they can only serve as secondary substrates. In either case, primary substrates are required to supply the major energy requirements for bacterial growth and/or for activation of enzymes necessary for the transformation. Chemical requirements for achieving co-metabolism are high. In addition, knowledge is lacking about methods for getting the correct amounts of chemicals to the locations where needed and in the form needed.

7617 **Environmental concerns associated with the design of genetic engineering facilities.** Watt, J.C.; Wroniewicz, V.S.; Ioli, D.F. (United Engineers and Constructors, Philadelphia, PA (USA)). pp 307-322 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

With the advent of genetic engineering processes, there is much concern regarding wastes generated by the facilities incorporating these processes and the potential effects of these wastes on the environment. The primary process employed in these facilities is fermentation utilizing recombinant DNA organisms. In the design of facilities employing this technology, critical consideration must be given to the protection of the environment, both in the prevention of releases of recombinant DNA organisms into the environment and in the treatment of wastes originating from the production facilities. The design requirements for containment of large-scale systems are complex and require detailed analysis to insure that the containment system can handle both the normal and emergency releases of recombinant DNA organisms. This must include the prevention of releases through either liquid discharges or air emissions. The killing method used in the process for either the cells or the broth is an important step and can have significant implications in downstream treatment of wastewaters.

7618 **Balancing regulatory control, scientific knowledge, and public understanding.** Kingsbury, D.T. (National Science Foundation, Washington, DC (USA)). pp 341-350 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

As biotechnology continued to grow and expand into non-medical applications, it became clear that many of the second-generation products were going to be the living organisms themselves and that most would be applied in the environment. This recognition led to a wave of concern regarding the environmental consequences of these products. Those expressing the most concern have focused on the possible negative environmental impacts of the new products and have generally disregarded the potential positive impact. The authors emphasizes the continued need for broad and vigorous basic research, with a balance between the fundamental work that may eventually lead to commercial products and the fundamental work that is necessary for an understanding of the interaction of many types of organisms within the environment. The author reiterates the need for balance in the regulatory approach so that we do not repress innovation in research and development. Over-regulation has many side effects. In addition to repressing innovation and not taking advantage of our research base, over-regulation leads to reluctance by the capital markets to invest in the future of our new industries, thereby halting their development at an early stage. At the same time, under-regulation leads to lack of confidence by the public and paralysis of the industry based on public outcry and legal proceedings.

7619 **Environmental pollution policies in light of biotechnological assessment: organization for economic cooperation, United Kingdom, and European economic council perspectives.** Bull, A.T.; Holt, G.; Hardman, D.J. (Univ. of Kent, Canterbury (England)). pp 351-371 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The authors review some major policy issues that will determine the pace and direction of environmental pollution control and the impact of biotechnology on the environment from OECD, United Kingdom, and European points of view.

7620 **Environmental protection agency actions to stimulate use of biotechnology for pollution control and cleanup.** Williams, M.E. (Environmental Protection Agency, Washington, DC (USA)). pp 373-379 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Until recently, the EPA's main focus in the biotechnology area has been in taking a look at new products--microbial pesticides or new chemicals--that a company is attempting to introduce into the marketplace. But the whole issue that the authors are addressing at this conference is the viability of biotechnology to be one of the solutions to our hazardous waste contamination problems. It is important for the EPA, Congress, the states, and other key players to assess the viability of this technology and to put into place a regulatory structure that, while protecting health and the environment, will encourage the development of such a set of technologies. One of the key objectives is regulatory stability. It's extremely hard for anybody to operate in an ever-changing regulatory arena.

## 1406 Photovoltaic Power Systems

*REFER ALSO TO CITATION(S) 7584, 7602*

7621 **(CRIE-T—87008) Utility interface problems and solutions for dispersed small scale PV ststems.** Takigawa, Kiyoshi; Kobayashi, Hiromu; Takeda, Yukihiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 38p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88755701/JAW.

In order to ensure the reliability and safety of utility grid in cases where dispersed customers' small scale PV systems were interconnected utility grid, the tentative plan of interconnecting spesifications with detailed numerical conditions for four items of power quality, operation and protection coordination characteristics, and working safety was proposed. Carrying out running tests by thirteen types of operational testing equipments filled with above requirements of the plan, the conditions were confirmed to be resolved by present technology. As a result, major solutions for a equipment design including the adoption of a voltage type self-commutated inverter and the stabilization by high speed over-current restriction function and by simple control loop were revealed. Furthermore, for the prevention of a dangerous RUN ON phenomenon required to resolve without delay, a new control method to prevent the phenomenon by the detection of frequency anomaly

with frequency bias added in a synchronous circuit of PV system was proposed. (15 figs, 7 tabs, 4 refs)

7622 **(Juel-Spez—415) Analysis of photovoltaic energy generation systems in addition to grid electricity supply, shown by a single-dwelling house.** Plewnia, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; Stuttgart Univ. (Germany, F.R.)). Sep 1987. 190p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756113/JAW.

The object of the study presented here is the generation of photovoltaic energy to supply the residential electricity demands. The degree to which the solar generator working parallel to the power supply system is able to take part in the provision of electricity is demonstrated by means of a computer simulation program. The outcome shows to which extend the power supply system has to help to prepare the balance by taking over surplus solar energy and/or by supplying the residential electricity lacking. Furthermore, the effect on a better efficiency by using a storage battery is analyzed. Indications of the size of a photovoltaic energy system of this kind are given and factors are described which descisively influence the costs of electricity based on solar energy. The study shortly considers the problems which result from installing a solar generator into the power supply system.

7623 **(N—88-28966) Thin film coatings for space electrical power system applications.** Gulino, D.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1988. 16p. (NASA-TM—101325; E—4336; NAS—1.15:101325; CONF-8809211—). NTIS, PC A03/MF A01.

From 2. international conference on surface modification technologies; Chicago, IL, USA (25 Sep 1988).

This paper examines some of the ways in which thin film coatings can play a role in aerospace applications. Space systems discussed include photovoltaic and solar dynamic electric power generation systems, including applications in environmental protection, thermal energy storage, and radiator emittance enhancement. Potential applications of diamondlike films to both atmospheric and space based systems are examined. Also, potential uses of thin films of the recently discovered high-temperature superconductive materials are discussed.

## 1407 Solar Thermal Power Systems

*REFER ALSO TO CITATION(S) 7623*

## 1408 Ocean Energy Systems

7624 **(CONF-880932—4) Technical developments of OTEC Systems.** Trenka, A.R.; Thomas, A.; Vega, L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004275/JAW.

From International renewable energy conference; Honolulu, HI, USA (18 Sep 1988).

The US Department of Energy's (DOE) Ocean Energy Technology Program seeks to develop the technology of converting the ocean's vast energy resource into usable forms to the point where industry can assess its potential, commercial utility. The current focus in the program is on the utilization of open-cycle OTEC to produce electricity. The open-cycle OTEC process is one of the few alternative energy options which provides the potential for baseload-carrying capability. This paper provides a very brief overview of the program activities and focuses on results recently obtained from the program's experimental facility designed to allow testing of OC-OTEC subsystems under actual operating conditions utilizing seawater. The facility, referred to as the Seacoast Test Facility (STF), is currently composed of a Heat and Mass Transfer Scoping Test Apparatus (HMTSTA) being supplied by up to 1600 gallons per minute of warm seawater and 1000 gallons per minute of cold seawater. Researchers have obtained experimental data on the performance of evaporators and surface condensers. Also, information on mist elimination and deaeration processes have been obtained. Plans call for modification to the HMTSTA to accommodate the addition of direct-contact condensers. Summary results will be discussed addressing recent studies, by Argonne National Laboratory (ANL), of corrosion and biofouling of aluminum alloy surface condensers. Also discussed is the production of desalinated seawater using an open-cycle OTEC process. Finally to be discussed will be recent developments in OTEC turbines and an assessment of seawater supply systems required for OTEC. A brief overview of the program's future plans also will be presented. 4 refs., 11 figs., 2 tabs.

7625 **(CONF-8810180—2) First production of potable water by OTEC [ocean thermal energy conversion] and its potential applications.** Thomas, A.; Hillis, D.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02 - OSTI. Order Number DE89003630/JAW.

From OCEANS '88; Baltimore, MD, USA (31 Oct 1988).

An experiment--the Heat and Mass Transfer Scoping Test Apparatus--was built to obtain design data for a larger test that will assess the technical feasibility of the open-cycle OTEC process. (The closed-cycle concept was successfully demonstrated in 1979.) The DOE-funded project is a joint effort between Argonne National Laboratory (ANL) and the Solar Energy Research Institute (SERI). The apparatus was erected at the Natural Energy Laboratory of Hawaii and became operational in the summer of 1987. It is used by both ANL and SERI to conduct open-cycle OTEC experiments. After initial debugging, it produced 350 gallons per hour of potable water having a salinity of 86 ppM, one-fifth that of local tap water available at the test site. 6 refs., 6 figs.

7626 **(SERI/TR—252-3108) Direct-contact condensers for open-cycle OTEC applications: Model validation with fresh water experiments for structured packings.** Bharathan, D.; Parsons, B.K.; Althof, J.A. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1988. Contract AC02-83CH10093. 272p. NTIS, PC A12/MF A01 - OSTI. Order Number DE89000822/JAW.

The objective of the reported work was to develop analytical methods for evaluating the design and performance of advanced high-performance heat exchangers for use in open-cycle thermal energy conversion (OC-OTEC) systems. This report describes the progress made on validating a one-dimensional, steady-state analytical computer of fresh water experiments. The condenser model represents the state of the art in direct-contact heat exchange for condensation for OC-OTEC applications. This is expected to provide a basis for optimizing OC-OTEC plant configurations. Using the model, we examined two condenser geometries, a cocurrent and a countercurrent configuration. This report provides detailed validation results for important condenser parameters for cocurrent and countercurrent flows. Based on the comparisons and uncertainty overlap between the experimental data and predictions, the model is shown to predict critical condenser performance parameters with an uncertainty acceptable for general engineering design and performance evaluations. 33 refs., 69 figs., 38 tabs.

## 1409 Solar Thermal Utilization

7627 **(DE—CON-2) Guide for the configuration and control of solar heating systems.** Lund, K.G. (Davis Engineering Ltd., Ottawa, Ontario (Canada)). 1980. 121p. (CE—02107). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides basic information on various components of solar systems, emphasizing the solar collector as the most critical component. A few of the many possible system configurations, as applied to residential buildings, are explored. Such systems can include space heating, water heating, and heat storage for either the short or long term. Some control strategies for these systems are examined, and their quantitative implications described. This is done through a computer simulation that is adaptable to any solar or conventional heating system. Examples are given of the results of simulating some of the more promising systems. A number of basic principles have been derived which are applicable to the

optimum operation of solar systems. Some conclusions and recommendations are as follows. The collection temperature, or average collector temperature, should be kept as low as possible. It is also worthwhile to design the heat distribution system for low temperature operation. If there is a significant water heating requirement, more solar energy will be collected by passing the water through the collector only once. Thermal stratification in the storage tank will result in improved performance. If seasonal or annual storage is to be installed, a dual-tank system should be utilized. A series of simulations that investigated the relative merits of on-off and proportional control systems showed there was essentially no thermal benefit to be derived from proportional control. Use of a heat pump to boost the temperature of the solar collected energy is recommended as a way to permit high collection efficiency at relatively low cost. 9 refs., 27 figs., 21 tabs.

7628 **(NP—9770152) Solar tent - a new, cheap and efficient air collector made of synthetic fabric.** Schulz, H. (Landtechnischer Verein in Bayern e.V., Freising (Germany, F.R.); Bayerische Landesanstalt fuer Landtechnik, Freising (Germany, F.R.)). Mar 1987. 15p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770152/JAW.

A novel type of air collector system is presented, which is based on the use of a permeable synthetic fabric. Outside air is sucked in through a porous, black synthetic fabric and heated by solar irradiation. The report deals with this collector system, which has already proved a success for several years in some practice installations, in connection with numerous schematic sketches and details on important technical data. The advantages of application of the system and, however, also the problems and restrictions which still exist (service life, even suction of air with the use of a fan, low-temperature viscosity, water vapour). Detailed information is given on the synthetic fabric (nicolon) and on the construction of a round-bale dryer (hay and straw) with an air collector made of synthetic fabric. Measurement results are given (diagram) and a solar dryer, driven by gravitational force, for agricultural products is presented. (HWJ).

7629 **(NP—9770153) Quality hay by use of solar collectors.** (Landtechnischer Verein in Bayern e.V., Freising (Germany, F.R.); Bayerische Landesanstalt fuer Landtechnik, Freising (Germany, F.R.)). [1988]. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770153/JAW.

Results are named of solar collectors which have been investigated up till now, it is reported on suitable drying procedures, and a computation method of dimensioning of collector installations for hay-drying is presented. In connection with sketches, the structural, functional and output specifications are given on roof tile collectors and sectional plates as absorbers for collector roofs, as well as on valve and hybrid collectors. Furthermore, the report deals with various industrially produced collectors and the simplified computation method (data specifications, states of computation) is elucidated. Finally, a bell-type dryer for round bales are shown, and an improved plastic sheet for drying round bales. (HWJ).

7630 **(NP—9770155) Passive use of solar energy - references to planning and structural components.** Prox, W. (Rationalisierungs-Gemeinschaft Bauwesen im RKW (RGB), Eschborn (Germany, F.R.)). 1987. 12p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770155/JAW.

The passive utilisation of solar energy is an effetive and economic alternative to 'active' solar technology. In the RG-Bau pamphlet 80, first of all various systems of utilisation of solar energy are presented (Trombe-wall, air collector, thermal buffer zone). The following references to planning refer to the situation on the property, windows (orientation, glazing, the evaluation of heat insulation technology) glass porches, temporary heat insulation (window flaps etc.), protection from the sun (summer heat) and heat storage (building materials). Furthermore, the solar contribution to heating energy is described as well as the adaptation of the heating system. In the appendix to the report, specialist publications on 'energy conservation in buildings', published by RKW (Rationalisation Curators of the German Economy) are listed. (HWJ).

7631 **(NP—9770172) Experimental investigation of solarthermal systems in Berlin (MESIB). Final report.** Hanitsch, R.; Valentin, G. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Elektrische Maschinen; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1987. 173p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770172/JAW.

From 1981 until 1986 ten solarthermal systems were investigated in Berlin. These systems were designed to produce domestic hot water only. The reliability and maintenance problems were looked at and the measured data formed a solid basis for the design of energy flow charts. In addition the efficiency and coefficient of performance were calculated. Solarthermal systems in northern Europe can contribute a lot to cover the hot water consumption; however the circulation losses have to be reduced considerably. (orig.) With 8 refs., 7 tabs., 50 figs.

7632 **(NP—9770176) Energy conservation and use of solar energy in open-air swimming-pools and in the multipurpose hall at Wiehl. Final report. Pt. H. Performance in service of the solar collector system for heating the pool water from 1976 to 1985.** Dreisbach, K. (Energietechnik G.m.b.H., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Department of Energy, Washington, DC (USA)). 1985. 19p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770176/JAW.

The solar collector system at the former large-scale trial installation for use of solar energy in Wiehl has been used for 10 years to heat the public open-air swimming-pool. The report describes regulation and technical security measures, incidents during the running of the collector system, performance in service and practical experiences with the running of the system. A range of improvements was carried out on the whole collector system from 1976 to 1980. The rate of return on the system could thereby be improved from 0.35 to 0,5. The town of Wiehl has had responsibility for running the system since 1981. Because of the lack of technical personnel to provide a full of the lack of technical personnel to provide a full maintenance of the system the rate of return on the system fell to 0.4. 91 percent of the collectors show evidence of corrosion at their welds. If corrosion continues, all collectors could corrode after 1986. On the basis of experience to date, the life of the collectors is estimated at approximately 15 to 20 years.

7633 **(NRC/E—SURVEY1) The national capital solar survey.** Gough, B.D. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1981. 48p. (CE—02110). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A survey was conducted in the Ottawa region in order to determine the number and type of solar thermal and photovoltaic systems in the area and to find out any trends that may be developing in local solar utilization. The survey encompassed active and passive systems for space heating and hot water production, and systems using photovoltaic conversion. A grand total of 179 systems were identified (70 active, 106 passive, 3 photovoltaic), and it is estimated that solar projects not identified during the survey would increase the total to about 300. When installation of solar systems is categorized by year of completion, the most apparent trend is that the total number of new solar projects is constantly increasing from one year to the next. Most of the increase in the last two years covered by the survey is attributable to passive solar systems. Detailed information on specific projects is also presented; these projects were selected on the basis of their unique or exemplary merit, completeness of data, and owner willingness to have the project photographed and published. 38 figs., 2 tabs.

7634 **(PB—89-111256/XAB) Large-scale Swedish solar-heating technology system design and rating.** Dalebaeck, J.O. (Chalmers Univ. of Tech., Goeteborg (Sweden)). 1988. 192p. (D—6:1988). NTIS, PC E07/MF A01.

A large number of calculations for investigation of solar-heating systems with seasonal heat stores, are presented in this report. The designs and ratings proposed are directly based on ex-

perience from, and research related to the existing plants. The reasoning and analyses in the report have mainly been developed, and follow on, from the work carried out in connection with two of these plants, Ingelstad and Lambohov. However, this does not mean that the report is concentrated on these installations as such, but rather on the entire Swedish research program for solar-heating systems with seasonal heat stores. The objective of the report is to collate and summarize the results of the program of research and to present some of the more-important aspects of the technology that can be derived therefrom.

## 1410 Solar Collectors And Concentrators

*REFER ALSO TO CITATION(S) 7628, 7629*

**7635 (AD-A—198807/0/XAB) Holographic solar-energy concentrators for solar-thermal rocket engines. Final report, June 1987-March 1988.** Renk, K.; Jacques, Y.; Felts, C.; Chovit, A. (NTS Engineering, Long Beach, CA (USA)). May 1988. 44p. (NTS—6006). NTIS, PC A03/MF A01.

This is a report on Holographic Concentrators for Solar Thermal Rocket Engines. The object of the work was to demonstrate that highly reflective holograms could be used as solar concentrators to heat liquid hydrogen for use as a propellant in satellite boost engines. The interest in this results from the need for a reliable, inexpensive alternate for conventional rockets.

**7636 (NRC/E—COLL-12) Effect of infra-red reflecting coatings on the performance of flat-plate solar collectors in Canada.** Hollands, K.G.T.; Shewen, E.C. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1979. 11p. (CE—02111). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Infrared reflecting coatings (IRC) applied to the surfaces of the various glazings in a flat plate collector can improve the collector's efficiency by reducing long-wave radiant heat losses. This paper quantifies this improvement for collectors used in solar heating systems in Canada. Computerized simulation was used to calculate operating efficiency for collectors used in three solar systems, chosen for purposes of comparison: a 60% function system in Toronto; a 45% system in Winnipeg, and a 75% system in Vancouver. Single and double glazed collectors, air-based or liquid-type, were simulated with and without a selective black chrome surface on the absorber plate, the alternative being black paint. Considering first the single-glazed collector, it was seen that IRC glazing gives 2-5% better performance than a black chrome selective collector. For the double-glazed collector, a design with IRC on both sides of the inner glazing gives a substantially better performance than any of the other collectors: the improvement in collector efficiency, with respect to the single plain glazed selective surface collectors, of 9.5 to 33% for the liquid-type collector and 26 to 58% for the air type. 4 refs., 7 tabs.

**7637 (NRC/E—COLL-13) A simple method for reducing condensation in flat plate solar collectors.** Lund, K.G. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1980. 21p. (CE—02108). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A prototype system has been developed which automatically extracts most of the moisture entrapped in the internal atmosphere of a typical flat plate solar collector without the application of external power. The system consists of an efficient condenser which forms part of a tubular loop attached to, but outside, the collector housing. When the ambient temperature drops below the dew point of the air inside the collector, the condenser causes moisture to condense externally and then to evaporate to the outside air by means of a wick. A breather hole in the side wall of the housing, fitted with a dust filter, completes the system, thus further protecting the collector from the damaging effect of particulate matter. Continuing development work is recommended, aimed at perfecting the system and confirming its efficacy over a prolonged period. 6 figs.

**7638 (NRC/E—SEP4) Wind simulation requirements for indoor solar collector testing.** Hamelin, L.L. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1980. 37p. (CE—02106). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Thermal efficiency of flat plate solar collectors depends, among other things, on the heat loss coefficient between the collector cover and the atmosphere. This coefficient is affected by the wind. A recent program to develop an indoor Canadian solar collector testing facility has resulted in the need to understand the effects of wind on solar collector performance, and to find out how the wind should be simulated at the testing facility. This paper presents the results of a study to determine the requirements for the simulation of wind conditions at that testing facility. A computer program was modified to simulate the thermal performance of a single-glazed, flat plate collector. A listing of this program in Fortran IV is given in the appendix. Results show that the outer glass convective heat transfer coefficient significantly affects collector performance. By using a uniform air flow across the collector in the range of 2.25-4.5 m/s, test results are shown to be repeatable: if such a flow is achieved +/- 1 mph, repeatable results should be produced to within 1 percentage point. This wind speed region also has the advantage of being representative of the Canadian environment. 15 refs., 9 figs.

**7639 (PB—89-115901/XAB) Five years' outdoor exposure of solar collectors. Renewed performance measurements and determination of the effect on thermal efficiency.** Bergquist, P. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 55p. (D—18:1988). NTIS, PC E04/MF A01.

During 1980/81, the Swedish National Testing Institute (NTI) measured the thermal efficiency and other parameters of virtually all the solar collectors available on the Swedish market at the time. One of the parties for whom the work was carried out was the National Board for Consumer Policies. All told, there were 17 different collectors (both Swedish-manufactured and imported), all water-cooled. After carrying out the tests, the collectors were mounted on the roof of one of the Institute's buildings for outdoor exposure under stagnation conditions, with the intention that they should provide data for assessing the overall life of the products. After about five years' outdoor exposure, an interim assessment was performed by remeasuring the thermal efficiency of some of the collectors, coupled with visual inspection to detect any changes.

**7640 (SAND—88-2620) Optical performance of the first prototype stretched-membrane mirror modules.** Alpert, D.J.; Johnson, D.K.; Houser, R.M.; Yellowhorse, L.; VanDer-Geest, J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004429/JAW.

The United States Department of Energy's solar thermal program is testing an innovative concept for the heliostats used in a solar central-receiver power plant: replacing the familiar glass mirrors with stretched-membrane reflectors. Because of their simplicity and lighter weight, heliostats using membrane reflectors have the potential to cost significantly less than glass-mirror heliostats. To assess the optical performance of these new heliostats, a 50- square-meter prototype mirror module, representative of a commercial-scale design, was built and installed for testing at the Central Receiver Test Facility at Sandia National Laboratories. Major issues addressed in the testing program included the optical performance of the stretched-membrane mirror, the performance of the mirror's focus-control system in windy conditions, the performance of the defocus system, and the durability of the reflective film. The results of the evaluation indicate that the size and shape of the reflected beam from this first-of-a-kind mirror module are at least as good as from current glass-mirror designs. In calm conditions, the mirror can be defocused to a convex focal length of -200 meters in 7 seconds. The optical performance on windy days was within Sandia's heliostat specifications. After 2 years of exposure, the reflective surface was generally in good condition, having a clean reflectivity of nearly 90%. 24 refs., 21 figs.

7641 **(SERI/SP—253-3212) Internal Film Receiver systems assessment study.** Anderson, J.V. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1988. Contract AC02-83CH10093. 68p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89000811/JAW.

This report documents SERI's Internal Film Receiver (IFR) design study and system assessment effort; and it compares the performance and economic potential of this system to conventional salt-in-tube receivers and to systems with the direct absorption receiver (DAR). SPECO, Inc., under contract to SERI, performed the receiver configuration work and their final report is included as Appendix A. The IFR is similar to the DAR in that both use films flowing over nearly vertical plates to absorb the solar energy. However, in the IFR the radiation strikes the outside of the absorber plate and the working fluid flows down the inside. The results of the system-level assessment indicate that the IFR concept has the potential to deliver levelized energy costs (LEC) on the order of 5%--7% lower than the salt-in-tube receiver. Although the potential economic benefits of the IFR are not as great as those for the DAR, which shows more than a 15% improvement in LEC over the salt-in-tube receiver system, this may be offset by the lower technical risks with the IFR. 3 refs., 2 figs., 7 tabs.

7642 **(WU/RI—EVAL2) A method for rating and sizing solar collectors in residential heating systems.** Hollands, K.G.F.; Chinneck, J.W.; Chandrashekar, M. (Waterloo Univ., Ontario (Canada). Research Inst.). 1977. 112p. (CE—02109). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A collector figure-of-merit is developed which evaluates the year-round performance of a flat plate solar collector used in residential heating systems at a particular location. Using this concept, a simplified method of collector sizing is developed. An economic figure-of-merit is also postulated. In order to evaluate the relevant parameters, computer simulations were carried out for eight major Canadian cities for both air and liquid-based systems, for five sets of collector specifications, for three proportions of heating done by solar energy solar fraction, and for three fractions of the total heating load due to domestic hot water. Results of the study show that the solar fraction is the most important variable in determining a collector's yearly performance. An index is developed denoting the difficulty of heating by solar methods in a given location. 9 refs., 5 figs., 56 tabs.

# 15 GEOTHERMAL ENERGY

## 1501 Resource Status And Assessment

7643 **(AD-A—197279/3/XAB) Geothermal potential of Marine Corps Air Station, Yuma, Arizona, and the western portion of Luke-Williams gunnery range. Progress report, 1984-1986.** Bjornstad, S.C.; Katzenstein, A.M. (Naval Weapons Center, China Lake, CA (USA)). Jan 1988. 63p. (NWC-TP—6827). NTIS, PC A04/MF A01.

This report details the geothermal resource exploration program at the U. S. Marine Corps Air Station, Yuma, Arizona, and vicinity, as requested by the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California.

7644 **(AD-A—197441/9/XAB) Preliminary geothermal exploration at the Marine Corps Air Ground Combat Center, Twentynine Palms, California. Preliminary report, December 1978-January 1984.** Katzenstein, A.M.; Whelan, J.A. (Naval Weapons Center, China Lake, CA (USA)). Sep 1987. 129p. (NWC-TP—6747). NTIS, PC A07/MF A01.

This report discusses the geological, geophysical, and geochemical investigations performed at the Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, near the the town of Twentynine Palms, Calif., to determine the existence and extent of geothermal resources on MCAGCC-controlled land.

7645 **(AD-A—199107/4/XAB) Coso monitoring program. Summary report, October 1986-September 1987.** Edwards, E.M. (Comarco, Inc., Ridgecrest, CA (USA)). Jun 1988. 113p. NTIS, PC A06/MF A01.

The Coso Monitoring Program is a continuing effort in support of the development of the Navy's geothermal resources within the Coso Known Geothermal Resource Area (KGRA).

7646 **(AD-A—199416/9/XAB) Geothermal resource evaluation at Naval Air Station Fallon, Nevada. Final report, June 1985-August 1986.** Katzenstein, A.M.; Bjornstad, S.C. (Naval Weapons Center, China Lake, CA (USA)). Aug 1987. 56p. (NWC-TP—6808). NTIS, PC A04/MF A01.

During the summer of 1986, Fallon Observation Hole 2 (FOH-2) was drilled in the southeast corner of Naval Air Station (NAS) Fallon, Nevada, to provide additional information on the geothermal resource at that installation.

7647 **(DOE/ID/12526—T6) Geothermal research, Oregon Cascades: Final technical report.** Priest, G.R.; Black, G.L. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA) ). 27 Oct 1988. Contract FG07-84ID12526. 155p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89003863/JAW.

Previous USDOE-funded geothermal studies have produced an extensive temperature gradient and heat flow data base for the State of Oregon. One of the important features identified as a result of these studies is a rapid transition from heat flow values on the order of 40 $mW/m^2$ in the Willamette Valley and Western Cascades to values of $\geqq 100$ $mW/m^2$ in the High Cascades and the eastern portion of the Western Cascades. These data indicate that the Cascade Range in Oregon has potential as a major geothermal province and stimulated much of the later work completed by government agencies and private industry. Additional data generated as a result of this grant and published in DOGAMI Open-File Report 0-86-2 further define the location and magnitude of this transition zone. In addition, abundant data collected from the vicinity of Breitenbush and Austin Hot Springs have permitted the formulation of relatively detailed models of these hydrothermal systems. These models are published in DOGAMI Open-File Report 0-88-5. Task 1.2 of the Deliverables section of Amendment M001 is fulfilled by DOGAMI publication GMS-48, Geologic map of the McKenzie Bridge quadrangle, Lane County, Oregon. This map was printed in October, 1988, and is part of the final submission to USDOE. 8 refs.

7648 **(GSJ—8702) Study on deep geothermal resource detection.** Ogawa, Katsuro; Kinbara, Keiji; Ito, Hisao; Ishido, Tsuneo; Sasada, Masakatsu; Tosha, Toshiyuki; Takeno, Naoto; Kikuchi, Tsuneo; Nishi, Yuji. (Geological Survey of Japan, Yatabe, Ibaraki). Dec 1987. 346p. (In Japanese). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88755741/JAW.

Since 1986, on the basis of the past study and the history of geothermal development, a study titled 'Fractured geothermal reservoir' was conducted on detection of a reservoir, mechanism of formation and method of evaluation. Time area CSMT has enables the detection at relatively deep region, which is effective in such noisy area as Japan. The aim of this study is to predict the fractured system from the result of the ground surface examination, to clarify the temperature, pressure and composition of the geothermal fluid in the fracture using a fluid enclosure in the geothermal minerals, and to clarify the clogging condition by the crystallization of the minerals. As for the method of evaluation, in order to clarify the characteristics of fracture, study is being made on the well test technology for the structure evaluation and the figurative simulation technology for the remodelling. (142 figs, 33 tabs, 170 refs)

7649 (GSJ—8703, pp 69-90) **Algorithm for evaluating wide range scale geothermal resources. In case of Mt. Hakkoda geothermal area.** Okubo, Yasukuni; Murata, Yasuaki; Ogawa, Yasuo; Takakura, Shin'ichi; Uchida, Toshihiro; Tsu, Hiroji. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

A new model was developed for the comparison of probability of wide range scale geothermal resources, extraction of regions worth developing, and estimation of the magnitude of resources. For applying the model, Mt. Hakkoda geothermal region was selected as an example. As for the designing of the model, conception of resorvoir rock was defined as hot water storing in the interuption of the ground or in the matrix of rocks. Magnitude of resources were given as probability. Data obtained by boring were used for the calculation of the model. It was scheduled to evaluate the Mt. Hakkoda geothermal region by using the model combined with miscellaneous databases. (15 figs, 1 tab, 21 refs)

7650 (GSJ—8703, pp 135-151) **Distribution and thermal source evaluation of Kinugawa welded tuff rock layer in the south of Tohoku areas.** Yamaguchi, Yasushi; Takakura, Shin'ichi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is II-8 of an interim report on research and development of the Sunshine Project for 1986. It was clarified in this report that, in the district of South Aizu area and the peripheries, the welded tuff rocks of the Post Miocene Epoch widely distributed, and estimation of the extrusive source was made possible. It was shown that the Kinugawa welded tuff layer spread from the west side of the Aizu Basin to the northern part of Gumma Prefecture. Nevertheless, it was concluded that the magma reservoir of Kinugawa welded tuff is already cold as a thermal source. Therefore, for a thermal source for hot springs distributed over the hot spring groups in this area, regionally hot heat flux or the volcanic activities of the Quarternary Period must be considered. (8 figs, 2 tabs, 15 refs)

7651 (GSJ—8703, pp 211-212) **Well data banking (1986).** Yano, Yusaku. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

In 1986, a Well Data Banking was conducted wherein the SIGMA (geothermal data base) for the wells were collected and digitalized. This is a continuation of the work started in 1980. Wells banked in 1980 is 24 wells in 7 districts, with total extended distance of 29,000 km. At this point, the well data base accommodated are 493 wells with extended distance 279 km. Contents of the banking conducted are data digitalization, input into the data base, and output of diagrams for the data checking, etc.. For the present, this data banking of SIGMA is only one case of digitalization concerning the data on the geothermal wells. (1 tab, 1 ref)

7652 (GSJ—8703, pp 215-220) **Existing data banking. Gravitational pole vicinity correction data.** Hiroshima, Toshio. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is IV-2 of an interim report of research and development of the Sunshine Project for 1986. A gravitational detection is made in Japan as a basic study of resources development; point of gravity measurement is already 200,000, with covering area of 150,000 km². However, the correction method of this gravitational data differs accordingly to the study groups thus lacking the unification. Data file with a unified correction treatment is, therefore, necessary. The correction of gravity data is mainly a topographic correction to remove the influence of 60 km range from the point of measurement. Five stages of topographic correction is conducted. data banking of pole vicinity correction was intensively conducted on the existing data in the south of Hokkaido and the Tohoku districts. This has come to contribute to the evaluation of the total banking number of 21,000 points with areas 16,000 km². (4 figs, 1 tab)

7653 (GSJ—8703, pp 223-246) **Preparation of an altitude data base system by a direct access file.** Nishi, Yuji. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources, Sunshine Project in 1986, Intermediate report on performance of research and development.

This is IV-3 of an interim report of research and development of the Sunshine Project for 1986. A simplified altitude data base system was prepared, using a direct access file, from an altitude data file of a national figurative information. As this system is usually formed, retrieved and corrected by Fortran, its grafting ability is high. It is simpler than the conventional SIGMA data base, and, in addition to its sufficient performance for the utilization of ordinary altitude data, it can be directly used from CMS, a user environment; it is rather easy to utilize than a map data base of SIGMA. (5 figs, 1 tab, 3 refs)

7654 **(LA—11410-MS) Recommendations report for the platanares geothermal site, Department of Copan, Honduras.** (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 150p. (EN;SP). NTIS, PC A07/MF A01 - OSTI. Order Number DE89003847/JAW.

A geothermal assessment of six previously identified sites in Honduras has been conducted by a team comprised of staff from the Los Alamos National Laboratory, the US Geological Survey, and the Empresa Nacional de Energia Electrica. The application of both reconnaissance and detailed scale techniques lead to the selection of Platanares in the Department of Copan as the highest potential site. Additional work resulted in the completion of a prefeasibility study at Platanares. We present here a tabulation of the work completed and short summaries of the results from these technical studies. We also present a brief model of the geothermal system and recommendations for additional feasibility work. Both English and Spanish versions of this report are provided in the same document. 18 figs., 5 tabs.

## 1502 Geology And Hydrology Of Geothermal Systems

*REFER ALSO TO CITATION(S) 7654, 9612, 9613*

7655 **(CRIE-U—87051) Investigations on hydrothermal activities by fluid inclusions in granodiorite and veins distributed in the Kurobe hot dry rocks, Toyama Prefecture, Japan.** Inohara, Yoshiki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755720/JAW.

By use of granodiorite boring cores obtained in the Kurobe tunnel called Kurobe hot dry rocks, the formation process of veins and fluid inclusions was revealed with precise observations by a polarization microscope and scanning electron-microscope, and the temperature changes of hydrothermal fluid in this area were investigated by measuring the homogenization temperatures of fluid inclusions in quartz crystals. As a result, at least five formations of veins and fluid inclusions were confirmed in this area, and the temperature of hydrothermal fluid tended to decline with formations, thus it was suggested that the temperature of geothermal source similarly declined with supplying source heat to fluid. As the method finding the changes of the temperature and activitu of hydrothermal fluid to estimate the heat history of geothermal source, the temperature measurement method of fluid inclusions became clear to be useful as well as the precise observations by cathodeluminescence images. (12 figs, 7 tabs, 13 refs)

7656 **(GSJ—268) Research in the Kurikoma geothermal area.** Yamada, Eizo; Hase, Hirokazu; Ogawa, Katsuo. (Geological Survey of Japan, Yatabe, Ibaraki). Mar 1988. 409p. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

The Geological Survey of Japan summerized 'Confirmation study of the effectivness of prospecting techniques for deep geothermal resources'. The area of which center is the Onikobe caldera, was positioned as the open type model because the cap rock development is poor and the area is supposed as a typical geothermal area where the fracture restraint is intense. The subject area is about 25km$^2$ of southern half of the Onikobe caldera. The Onikobe Geothermal Power Generating Station has been operated since 1975 by the Electric Power Development Co. in the center of the Kurikoma area, and subsurface data acquired for the construction of the Power Generating Station are incorporated in the underground structure model of this area. The contents of performed confirmation study are the analysis of physical exploration data by NEDO, the analysis of bore hole cores and existed cores, the thermal structure numerical analysis and numerical modeling, and further the analysis and evaluation of complementary gravity data and magnetotelluric data. The hot area spreading in the deep underground is found to be larger than the initial expectation at the present when the 1500m bore hole survey has been completed. (8 refs)

7657 (GSJ—268, pp 19-36) **Pre-neogene basement rocks from the core holes KR-1 and KR-5 in The Onikobe caldera, Northeast Japan.** Sasada, Masakatsu. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The core holes KR-1 and KR-5 in Onikobe caldera penetrated the pre-Neogene basement rocks below 1213.6m and 263m respectively. The basement rocks from KR-1 consisted of tonalite which was often crushed to be cataclasite. In the crushed zone of about 1332m depth where the conduit of hot water was formed, remarkable crushing and altreation were found, resulting alunite, pyrophyllite and anhydrite. The basement rocks of KR-5 were composed mainly of tonalitic mylonite, psammitic schist and basic schist and subordinately of pelitic schist and ultramafic schist. The core hole penetrated mylonitic rocks in Onikobe-Yuzawa mylonite zone and the basement rocks were mylonitized and was further crushed to be cataclasite. The east side of Onikobe-Yuzawa mylotite zone settled relatively at the boundary of the fracture zone which runs parallel to Onikobe-Yuzawa mylotie zone. (7 figs, 2 tabs, 11 refs)

7658 (GSJ—268, pp 37-59) **Kitagawa dacite, pyroclastic flow deposits around the Onikobe caldera, northeast Japan.** Sakaguchi, Keiichi; Yamada, Eizo. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The pyroclastic flow deposits since the end of Pliocene Epoch which was so far summerized as the Kitagawa Dacite existed from Onikobe to Furukawa area, northwest Miyagi Prefecture, was surveyed to describe each deposit. The Kitagawa welded tuff is classified into pre-Ikezuki pyroclastic flow deposits, the Ikezuki Tuff, the Nizaka Tuff, and the Yanagisawa Tuff in ascending order. The Ikezuki Tuff was dated as 2.4-1.7Ma and confirmed to be the source of the Onikubo caldera. The Nizaka and Yanagisawa Tuffs were the basal air-fall deposits which were younger than 0.1Ma and supplied from the Narugo Basin. In addition. the main welded tuff distributed in the Kurikoma geothermal area was surveyed to report the date obtained newly. It was clarified that the designation of the Kitagawa Dacite includes vagueness, so that it is necessary to use the designation of individual pyroclastic flow deposit hereafter. (5 figs, 4 tabs, 30 refs)

7659 (GSJ—268, pp 61-189) **Geologic development of the Onikobe caldera, northeast Japan, with special reference to its hydrothermal system.** Eizo, Yamada. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

Detailed field surveys and borehole cores on the volcanic stratigraphy and geological structures of Onikobe caldera were carried out by conducting petrographic observation, chemical analysis and dating to clarify the geological development of Onikobe caldera and to discuss the underground of geological process. The geothermal system of Onikobe caldera was studied on the basis of the above geological development, geothermal indications and data of rock alteration. These were compared with other geologic development of the depressed caldera to elucidate the diversification. A computer was utilized to analyze the data of fracture zone and to simulate the hydrothermal system. The long term volcanism in Onikobe caldera can be explained by the replenishment of magma to the reservior or the magmatic convection heat from the magma reservior. The solidified high temperature rock mass intruded from the magma reservior located the southeast of the caldera and the hydrothermal system was thought to be formed on the upper part of the rockmass. (30 figs, 7 tabs, 137 refs)

7660 (GSJ—268, pp 191-210) **Geology of the north Kurikoma geothermal area, Akita prefecture, northeast Japan.** Takeno, Naoto. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The collapse structure in the geothermal area spreading over Minase Village, Okachi Town and Yuzawa City, southern part of Akita Prefecture, was investigated geologically. Surface geologic survey, well cores analysis and K-Ar dating were carried out. As the results, the Trageyama Formation of acidic volcanic rock which distributes in the geothermal zone of Kurikoma northern area, was divided into three members, the Minasegawa Tuff Member, the Oyu Welded Tuff Member and the Trageyama Tuff Member. The uplift of breccia near the Koyasudake indicated the possibility to ascend to the Sanzugawa Formation. It was clarified that the Torageyama Tuff Member gave 6-5Ma and 3-4Ma respectively, and that a part of the Torageyama member was interfingered to the Tentokuji Period and with a part of the Sanzugawa Formation. The collapse structure is thought to be a kind of caldera and these formations can be thought to be the pyroclastic flow deposits and lacustrine sediments. This caldera was designated 'Ogachi Caldera'. (13 figs, 1 tab, 25 refs)

7661 (GSJ—268, pp 211-227) **Tritium content in thermal waters from the Onikobe area and chemical composition of thermal fluids from the bore-holes KR-1 and KR-2.** Hirukawa, Takashi; Abe Kikuo. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

Following conclusions were obtained on the fluid composition from the existing chemical data and from the bore-holes by the NEDO, to determine the chemical properties of fluid and gas distributed in the Kurikoma geothermal area and to clarify the hydrothermal system in the area. The hot springs in the northern Kurikoma, the Onikobe caldera and Naruko area from the center to the surrounding vary from high to medium temperatures, from acidic pH through neutral to alkaline pH, and from $SO_4$ type to Cl type and further to $HCO_3$ type. The main composition of the erupting gas from the Jigoku area was acidic gas ($H_2S$, $CO_2$, and $SO_2$). In the Onikobe caldera, a large amount of acidic thermal fluid contains higher amount of tritium than that in the neutral and alkaline fluids, suggesting that low pH thermal fluid stays underground for shorter time. The thermal fluid discharged from KR-1 is neutral and contains medium NaCl and the thermal fluids from KR-2 is also NaCl type. (4 figs, 4 tabs, 30 refs)

7662 (GSJ—268, pp 229-244) **Rock alteration and hydrothermal systems in the Onikobe geothermal area, northeast Japan.** Takashima, Isao. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The surface and underground alterations in the Onikobe area were analyzed to determine the relation between the hydrothermal activity. The Katayama area where the Geothermal Power Sation is operated, is characterized by acid alteration but the western Fukiagesawa area is characterized by alkaline alteration containing zeolite. The alkaline alteration with predominant zeolite lie in the shallow part of Katayama area and the acidic alteration containing pyrophyllite develops in the deep underground. These alteration is thought that two times or more alteration was overlapped from the existence of relic mineral altered by higher temperature in lower temperature area and from the paleogeotemperature evaluation due to quartz transition temperature. The origin of acid fluid is considered to be the pre-existence of acid alteration zones where there had been no power to neutralize upflow acid fluid. The present neutral thermal fluid being utilized for power generation is thought that the deep acid thermal fluid is neutralized by the shallow rocks. (10 figs, 6 tabs, 18 refs)

7663 (GSJ—268, pp 245-262) **Hydrothermal rock alteration and geothermal system in the north Kurikoma geothermal area Akita prefecture, northeast Japan.** Kinbara, Keiji. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The geology of the North Kurikoma area is composed of the pre-Tertiary granite basement, and Neogene, Miocene and Quaternary formations in the ascending order, and the formation lower than the Torageyama formation was altered to the green tuff over the wide area by the appearance of the chlorite. The acidic alteration zones(silicified, kaolinite and alunite zones) and alkaline alteration zones (chlorite zone associated with laumontite and wairakite) generated by the geothermal activity distribute widely on the surface in this area. The wide hot area confirmed by the well survey are thought to be the hot igneous body penetrated during the pre-Tertiary Period and the alteration survey suggests that the higher gravity anomalies area which exists between Kawaharage-Ishigamiyama connecting line, reaches to the shallowest location from the surface. It is thought in this area that high temperature hydrothermal convection system originated from rainfall due to the igneous body have been formed in the fractured type geothermal reserviors of Neogene, Tertiary and pre-Tertiary formations. (12 figs, 1 tab, 34 refs)

7664 (GSJ—268, pp 263-283) **Development of geothermal reservoirs charged by convective heat transfer in vertical fracture.** Sugihara, Mitsuhiko; Ishido, Tsuneo. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The mechanism to form the geothermal reserviors charged by convective heat transfer from deep heat source to a shallow aquifer was numerically analyzed by considering the uplifting of geothermal fluid in vertical fractures. The aquifer locates in upper zone and high temperature zone (magma) locates in the deep rockmass and a vertical fracture connects both locations in this model. That is, it was assumed that the hydrothermal fluid flew through the vertical fracture and transfered heat from the deep rockmass to the aquifer to form the reservior. Following points could be confirmed as the results: It is difficult to form the natural convection in the vertical fracture exchanging heat around the rockmass but once the convection is formed, the convection is stable and the convective flow appears in the form of vertically oriented fingure like cell. The reservior is formed by the aquifer on the upper part on the vertical fracture. When another vertical fracture locates near the vertical fracture, the larger scale convection is formed, resulting the predominant geothermal reservior. The features of geothermal structure in the Onikobe area can be explained by using this model. (13 figs, 1 tab, 19 refs)

7665 (GSJ—268, pp 285-313) **Gravimetric analysis of the Kurikoma geothermal area, northeast Japan.** Komazawa, Masao; Murata, Yasuaki. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

It was found that the gravity of the upheaval area around the Zanno-mori was overestimated from the results of two dimensional and multilayer gravity analysis by assuming density corresponding to the geological sections for the two estimated profiles in the Onikobe caldera. The average boundaries could be estimated 0.35km, 1.3km and 7.8km from the results of the power spectrum of Bouguer anomalies for all Kurikoma area determined by frequency analysis, and the model profiles having appropriate four layers could be established. The depth of lower density Quaternary geology and configuration of basal plane were determined by making three dimensional analysis, referring to the above results. The geothermal indicating locations were found at larger dip, and it could be estimated on the whole that there are fracture zones relating to the plate movement on the gravity bent zone from the Ishinomaki Bay to the Oga Peninsula. (21 figs, 1 tab, 36 refs)

7666 (GSJ—268, pp 315-331) **Interpretation of magnetotelluric data in the Onikobe caldera, northeast Japan.** Ogawa, Yasuo; Uchida, Toshihiro; Sato, Isao; Kikuchi, Tsuneo. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

The apparent resistivity distribution was studied and the geological structure and the geothermal system in the Onikobe caldera was considered by analyzing magnetotelluric data obtained by the NEDO and carried out as a part of the confirmation study of the effectiveness of prospecting techniques for deep geothermal resources in the Sunshine Program. The overall resistivity distribution in the Onikobe caldera was grasped from the mapping of the apparent resistivity and Tippers and the two dimensional modeling using forward and inverse programs was carried out. The high resistivity basement of granodiorite could be estimated at the 1-2km deep location in the caldera and this basement was estimated to be deeper between the Fukiage hot spring and Katayama. It can be interpreted that the granodiolite was fractured and altered from this phenomenon. The Katayama area where the geothermal activity is active, contains the low resistivity area of 10ohm.m or less up to 200m depth owing to the geothermal alteration, but the deeper zone has higher resistivity than the surrounging area. Katayama area showed horst structure, and this horst is important to provide the vertical fractures by which thermal fluid can be supplied. (9 figs, 1 tab, 46 refs)

7667 (GSJ—268, pp 7-18) **Results of researches in the Kurikoma geothermal area, northeast Japan. Overview.** Yamada, Eizo; Hase, Hirokazu. (Geological Survey of Japan, Ibaraki, Japan). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755740/JAW.

In Research in the Kurikoma geothermal area.

As a part of 'Confirmation study of the effectiveness of prospecting techniques for deep geothermal resources' carried out in cooperation with NEDO since 1980, the Geological Survey of Japan (GSJ) has conducted various kinds of researches in the Kurikoma area, that is, geological, geothermal and chemical gas, heat discharge and gravity surveys; reanalysis of the MT and Schlumberger electric exploration data obtained by the NEDO, examination of cores from six bore-holes(1220m-1500m deep) drilled by the NEDO at the south area of the Onikobe caldera, and numerical analysis of the geothermal analysis. The surveyed results were summerized from the points of geological and geothermal structures. It was verified that the early underground geological and geothermal model of the caldera was fairly accurate from the drilled six boreholes data, although several minor modifications became necessary. (1 fig, 27 refs)

7668 (GSJ—8703, pp 11-43) **Drawing 1/100,000 scale geological map of Mt. Hakkoda geothermal district.** Muraoka, Hirobumi; Takakura, Shin'ichi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

Geological map of geothermal district of Mt. Hakkoda was made which included the main volcanos created after Pliocene era. For the purpose, geothermal liquid, terrestial heat sources and its storing structures, were studied with consulting geological map. Aerial and satelite photographs were used for the study of faults, foldings, and dikes,. By the result, stratigragic order of layers, developing process of vocanos, and evoluting process of magma, were summarized for report. (5 figs, 4 tabs, 101 refs)

7669 (GSJ—8703, pp 123-132) **Ejection age of volcano rocks and trend of volcanic activity.** Sakaguchi, Keiichi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is II-7 of an interim report on research and development of the Sunshine Project for 1986. This report considers on the trend of volcanic activities in the South of Kyushu area. K-Ar age measurement was newly made and reported. Age values obtained were 1.09 plus minus 0.21 Ma for Nagaoyama andesite, 1.33 plus minus 0.18 Ma for Nozato andesite, and 0.3 plus minus 0.1 Ma for Imuta volcanos. Including these age values, from the age values and their distribution of the volcanic rocks in the South Kyushu district, the following three districts were selected to represent the volcanic activities since the Pliocene Epoch. As these districts are mutually overwrapped, verification at these overwrapped districts are necessary. (4 figs, 1 tab, 12 refs)

7670 (GSJ—8703, pp 197-208) **Method of resources evaluation parameter analysis. Volume method and tank model.** Miyazaki, Yoshinori. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is III-1 of an interim report on research and development of the Sunshine Project for 1986. This study carried out a simulation analysis using a tank model in order to conduct an accurate resource evaluation than the volume method by utilizing various informations on physical properties of geothermal reservoir which had been accummulated with the progress of geothermal survey. In this study, by means of the above two methods, quantitative study of how the evaluated values differed was conducted; difference in the mechanism of heat recovery which was the basis for the method was described. A factor called a recharge factor assumes an inflow rate of a reinjected water is adopted in the tank model; this value closely related with the recovery of the heat of the rocks. For the volume method, the mechanism of rock heat recovery is not clearly known thermodynamically. (6 figs, 2 tabs, 11 refs)

## 1503 Geothermal Exploration And Exploration Technology

*REFER ALSO TO CITATION(S) 7648, 7656, 7667*

7671 **(CRIE-U—87052) Development and application of controlled source audiofrequency magneto telluric method. Results of experiment at Akagi, Sakurajima, Kuju volcanos.** Kusunoki, Ken'ichiro; Suzuki, Koichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 35p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Central Reserch Inst. of Electric Power Industry has carried out prospecting experiments, in various places, with magneto telluric method (MT method) which employs natural electromagnetic wave, and has confirmed the effectiveness of the method in estimation for location of faults, distribution range of rocks, and structure of geothermal sources. With increase in accuracy, the MT method, which was suitable for the approximate prospecting in wide areas, was considered to become useful for determination of detailed geothermal structures directly under prospective points of geothermal wells. For the increase in accuracy, it was necessary to increase the kind and intensity of electromagnetic wave. Consequently, we developed, first as domestically, an unit of controlled source audiofrequency magneto telluric method. The unit, generating artificially electromagnetic wave, is useful for underground structure prospecting. Fundamental experiment on transmission and reception of electromagnetic wave was carried out as preparations for full-scale prospecting, then the structures of volcanos were prospected resulting in the determination of thickness distribution of shirasu layers and heat transfer route from magma reservoirs up to ground surface. (19 figs, 11 refs)

7672 **(GSJ—267) Geochemical thermometry of the thermal waters from forty-five main geothermal fields in Japan.** Hirukawa, Takashi; Takahashi, Masaaki; Shigeno, Hiroshi. (Geological Survey of Japan, Yatabe, Ibaraki). 25 Mar 1988. 746p. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88755739/JAW.

By using the chemical composition data of 45 geothermal fields contained in the database of hydrothermal water geochemistry, calculations of geochemical thermometer were conducted to make table of the thermometer, correlation graphs, and distribution maps. AS for the calculation method, geochemical thermometer was applied to estimate the temperature of geothermal reservoir by using the data of chemical and isotope composition of geothermal liquid. In addition, correlations between specific alkaline temperature of Na-K-Ca and temperature of quartz silica, and between concentration of chlorine were produced. Data were registered to geochemical database with names of hot springs, their altitudes, latitudes, and types of samples. (360 figs, 92 tabs, 17 refs)

7673 **(GSJ—8703) Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.** (Geological Survey of Japan, Yatabe, Ibaraki). Oct 1987. 227p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

This is an intermediate report on the performance in 1986 of three sub-themes concerning the evaluation technology of geothermal resources in Japan. Regarding the study of evaluation of nation-wide resources, geothermal resources were studied quantitatively by applying volumetric method. In case of study of wide range domain, 5 locations were selected for investigating the distribution maps of volcanic rocks, precise gravity and specific electric resistance and other items. By analyzing those data, nation-wide geothermal resources were evalua ted precisely. In addition, soft ware for registering these data in the database was studied.

7674 (GSJ—8703, pp 7-8) **Study on the evaluation of geothermal resources in Western Hokkaido.** Okubo, Yasukuni; Muraoka, Hirobumi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

Regarding the region of Mt. Niseko, western Hokkaido, extraction of promising geothermal domain as geothermal resouces was conducted by using CSAMT and MT methods, together with maps of gravity and terrestrial magnetism. By consulting terrestrial magnetism map, it was presumed that Niseko volcanic domain, where negative anormaly of gravity existed, might have formed the basin and that, at high gravity area in the domain, upheaval might exist. Thickness of lava was estimated from the data of CASMT meaurements. It was also presumed that, by consulting the map of terrestrial magnetism, rock intrusion might exist in the vicinity of Mt.Yotei. (2 refs)

7675 (GSJ—8703, pp 47-65) **Drawing of thermal gradient map for Mt. Hakkoda geothermal region.** Okubo, Yasukuni; Muraoka, Hirobumi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

Drawing of geothermal temperature gradient map of Mt. Hakkoda geothrmal region was conducted, and correlation with other data and reliability of the map were studied. For the purpose, thermal gradient map was drawn by using the boring data of 174 points. By this map, it was recognized that Mt. Hakkoda volcanic mountains and their vicinities showed steep thermal gradient. The map also showed good coincidence with volcanic history, distribution of hot springs and geochemical anion index. All of those indicated that Mt.Hakkoda volcanic moutains were promising region as geothermal resources. (7 figs, 2 tabs, 22 refs)

7676 (GSJ—8703, pp 169-194) **Model field resources evaluation and reanalysis of Curie isotherm surface.** Miyazaki, Yoshinori. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is II-10 of an interim report on research and development of the Sunshine Project for 1986. In the Kirishima volcanic area in the South of Kyushu, reanalysis of Curie isothermal surface by means of a spectrum method was carried out. In other words, in the Kirishima area, the Curie isothermal surface was the deepest at directly below the volcano with several km depth, as observed by the aeromagnetic survey. Magnetic model adopted was what coincided with the Kirishima geological model; magnetization of respective rocks used was a core value of the geothermal wells. The result of analysis showed no contradiction in the thermal flow in the Kirishima volcanic area. Further analysis of such a Curie isothermal surface will be applied to each geothermal model field to connect the results with the geothermal resources evaluation in wider areas. (17 figs, 3 tabs, 11 refs)

## 1504 Legal And Institutional Aspects

7677 **(DOE/SF/16299—T9) Impact of geothermal technology improvements on royalty collections on Federal lands: Volume 1.** (Meridian Corp., Alexandria, VA (USA)). Oct 1988. Contract AC03-86SF16299. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004415/JAW.

The purpose of this study was to predict the value of increased royalties that could be accrued through the year 2010 by the federal government as a result of the accomplishments of the US Department of Energy (DOE) geothermal research and development (R&D) program. The technology improvements considered in this study coincide with the major goals and objectives of the DOE program as set forth in Section 3.0 and will: allow the geothermal industry to maintain a long-term competitive posture in the more favorable fields; and permit it to become competitive where the resource is of lower quality. The study was confined to power generation from liquid-dominated hydrothermal geothermal reservoirs. The technologies for exploiting the liquid-dominated, or hot water, fields for power generation are relatively new and still under development. Thus, each technology enhancement that permits greater economic use of the resource will potentially enhance royalty revenues. Potential royalty revenue from dry steam power production at The Geysers, direct use of geothermal fluids, and use of advanced geothermal technologies (i.e., hot dry rock, magma, and geopressured) has not been considered in this assessment. 12 refs.

7678 **(DOE/SF/16299—T10) Impact of geothermal technology improvements on royalty collections on federal lands: Volume II: Appendices.** (Meridian Corp., Alexandria, VA (USA)). Oct 1988. Contract AC03-86SF16299. 190p. NTIS, PC A09 - OSTI. Order Number DE89004416/JAW.

This volume contains the appendices for the "Impact of Geothermal Technology Improvements on Royalty Collections on Federal Lands, Final Report, Volume I." The material in this volume supports the conclusions presented in Volume I and details each Known Geothermal Resource Area's (KGRA's) royalty estimation. Appendix A details the physical characteristics of each KGRA considered in Volume I. Appendix B supplies summary narratives on each state which has a KGRA. The information presented in Appendix C shows the geothermal power plant area proxies chosen for each KGRA considered within the report. It also provides data ranges which fit into the IMGEO model for electric energy cost estimates. Appendix D provides detailed cost information from the IMGEO model if no Geothermal Program R&D goals were completed beyond 1987 and if all the R&D goals were completed by the year 2000. This appendix gives an overall electric cost and major system costs, which add up to the overall electric cost. Appendix E supplies information for avoided cost projections for each state involved in the study that were used in the IMGEO model run to determine at what cost/kWh a 50 MWe plant could come on line. Appendix F supplies the code used in the determination of royalty income, as well as, tabled results of the royalty runs (detailed in Appendix G). The tabled results show royalty incomes, assuming a 10% discount rate, with and without R&D and with and without a $0.01/kWh transmission cost. Individual data sheets for each KGRA royalty income run are presented in Appendix G.

7679 **(DOE/SF/16299—T11) The Public Utilities Regulatory Policy Act (PURPA) and US Geothermal Industry: Current controversies and trends in federal and state implementation.** (Meridian Corp., Alexandria, VA (USA)). Sep 1988. Contract AC03-86SF16299. 64p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004417/JAW.

This report is an analysis of the issues confronting US energy policymakers and the US geothermal industry as the result of the implementation and interpretation of the 1978 Public Utility Regulatory Policies Act, commonly known as PURPA. It seeks to answer four sets of questions about PURPA: (1) What has the existence of PURPA meant to the US geothermal industry? (2) How has the interpretation of PURPA evolved over the past decade? (3) What particular portions of PURPA rule making have been most crucial to the growth and development of the geothermal industry? (4) What aspects of PURPA have been most troubling to utilities purchasing or developing geothermal energy?

## 1505 Economic And Financial Aspects

*REFER ALSO TO CITATION(S) 7677, 7678, 7679*

## 1508 Geothermal Power Plants

*REFER ALSO TO CITATION(S) 7679*

7680 **(EGG-EP—8132) The Kalina cycle and similar cycles for geothermal power production.** Bliem, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1988. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004875/JAW.

This report contains a brief discussion of the mechanics of the Kalina cycle and ideas to extend the concept to other somewhat different cycles. A modified cycle which has a potential heat rejection advantage but little or no performance improvement is discussed. Then, the results of the application of the Kalina cycle and the modified cycle to a geothermal application (360{degree}F resource) are discussed. The results are compared with published results for the Kalina cycle with high temperature sources and estimates about performance at the geothermal temperatures. Finally, the conclusions of this scoping work are given along with recommendations of the direction of future work in this area. 11 refs., 4 figs., 1 tab.

## 1509 Geothermal Engineering

7681 **(LA-UR—88-3985) Anomalous earth stress measurements during a six-year sequence of pumping tests at Fenton Hill, New Mexico.** Brown, D.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 25p. (CONF-880697—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003601/JAW.

From 2. international workshop on hydraulic fracturing; Minneapolis, MN, USA (15 Jun 1988).

Since 1982, the Los Alamos National Laboratory has been conducting fracturing and flow-through tests on a deep region of jointed Precambrian rock underlying the western flank of the Valles Caldera, in the Jemez Mountains of north-central New Mexico. These experiments have been conducted as part of the Laboratory's Hot Dry Rock (HDR) Geothermal Energy Project, at our Fenton Hill Test Facility, 30 km west of Los Alamos. During this time, the overall project goal has been to experimentally study (and model) the development and performance of a commercial-sized HDR reservoir -- created hydraulically by multiply-fracturing a very large region of hot crystalline rock. One of the primary objectives of this extensive series of fracturing tests has been to study how hard "competent" rock dilates and shears during the continuing injection of water under pressure. In association with these tests, a number of seemingly anomalous results have been observed which, if taken separately, would have been fairly easy to ignore or explain anyway. However, in concert, these disparate results have started to form a picture of rock deformation which is quite different from our previously accepted concepts of hydraulic fracturing, and the interpretation of the resulting stress measurements. Key to this better understanding is the realization that almost all bodies of deep crystalline rock are already flawed by one or more sets of joints or planes of weakness, and that it is the interaction between these joints and the existing stress field determines the nature of the pressure-induced deformation. 16 refs., 8 figs., 2 tabs.

7682 **(PB—88-252440/XAB) Circular of the Government Industrial Research Institute, Tohoku, No. 8, December 1987. Special issue: development of geothermal materials (production of composite pipes by centrifugal-thermit process).** (Government Industrial Research Inst., Tohoku, Sendai (Japan)). 1987. 46p. NTIS, PC E03/MF A01.

Text in Japanese with English abstract. See also PB—88-252408.

Contents include the following: Introduction; Production of Composite Pipe by the Process; Effects of Centrifugal Force on Produced Composite Pipes; Characteristics of the Composite Pipes; Characteristics of Thermit Reaction in the Process; Corrosion-resistance of the Composite Pipes; and Afterword.

7683 **(SAND—88-2370C) Scientific drilling technologies for hostile environments.** Traeger, R.K. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-8808158—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003266/JAW.

From International symposium on super-deep continental drilling and deep geophysical research; Yaroslavl, USSR (23 Aug 1988).

This paper briefly reviews the current United States Department of Energy Continental Scientific Drilling Program for Thermal Regimes and the related technologies being developed for geothermal drilling. Plans for penetrating into a molten magma body at temperatures from 800 to 1000{degree}C are also reviewed. 7 refs., 3 figs., 1 tab.

7684 **Openhole packer for high-temperature service in a 500°F precambrian wellbore.** Dreesen, D.S.; Miller, J.R.; Halbardier, F.A.; Nicholson, R.W. (Los Alamos National Lab. (US)). *SPE (Society of Petroleum Engineers) Production Engineering;* **3**: No. 3, 351-360(Aug 1988).

An openhole packer system has been designed, fabricated, and tested. The system has been used to isolate zones, to conduct injection tests, and to stimulate a 500°F [ 260°C] hot dry rock (HDR) geothermal reservoir. After exposure to temperatures of 460°F [238°C], the packer has functioned at differential pressures up to 5,500 psi [38 MPa]. Three high-pressure, massive hydraulic fracturing operations, each injecting more than 1 million gal [3800 m/sup 3/] of water, have been conducted with the packer system.

## 1520 Geothermal Data And Theory

*REFER ALSO TO CITATION(S) 9623, 9624*

7685 **(DOE/ER/13228—T3) Microfracturing in Westerly granite experimentally extended wet and dry at temperatures to 800{degree}C and pressures to 200 MPa.** Hopkins, T.W. (Texas A and M Univ., College Station (USA)). May 1986. Contract FG05-84ER13228. 84p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89003873/JAW.

Microfracturing in Westerly granite specimens, extended wet and dry, at temperatures to 800{degree}C and confining pressures to 200 MPa, is analyzed with a view toward understanding why, in the brittle field, rock strengths decrease with increasing temperature. Intragranular (IGC) and grain-boundary cracks (GBC) are mapped in two dimensions on either side of the tensile macrofracture, using optical microscopy, to determine, quantitatively, crack lengths and densities and, qualitatively, crack widths and orientations are visually examined to aid in interpretation. Temperature and confining pressure tend to favor the development of different microfracture fabrics. Thermal stresses produce a random orientation of cracks while stresses resulting from the external differential loading of a specimen produce a preferred orientation of cracks parallel to the direction of $\sigma_1$. In dry experiments, between 600{degree} and 800{degree}C, both GBC and IGC densities increase with increasing temperature. The increase in crack abundance is responsible for the thermal weakening of the rock. With increasing temperature, GBC play a greater role in the deformational history leading to rock failure. 27 refs., 24 figs.

## 16 Environmental Aspects

*REFER ALSO TO CITATION(S) 9632*

# 17 WIND ENERGY

*REFER ALSO TO CITATION(S) 7960*

## 1701 Availability (climatology)

*REFER ALSO TO CITATION(S) 9278*

7686 **(NRC/E—TM-WE-003) Wind energy, technical memorandum, energy programs branch.** Bolsco, S.L. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1980. 78p. (CONF-8010390—; CE—02115). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From WERAS '80: wind energy resource assessment seminar; Ottawa, Canada (30 Oct 1980).

A seminar was held to bring together the major parties involved in wind energy research and development in Canada. Presentations were made on current and future status of various wind energy projects, and a summary was made of information needs brought out during the seminar. This report summarizes presentations on: the Canadian Wind Energy Research and Development Program, the Atmospheric Environment Service Wind Energy Program, wind resource assessment activities at the National Research Council, the British Columbia Hydro and Power Authority, and wind energy assessment activities at the Institute of Man and Resources (including the Atlantic Wind Test Site). Data requirements needed by wind energy equipment designers and manufacturers are also described, with some suggestion as to what kinds of data should be collected by wind energy assessment projects in order to provide information helpful to wind energy users. 21 refs., 11 figs., 2 tabs.

## 1703 Regulations

**7687 (ECN-PB—88-6) Measurements of acoustic noise production of an Aerotech 17PI100 wind turbine at the wind turbine test station of ECN.** Van der Borg, N.J.; De Vries, P. (Netherlands Energy Research Foundation, Petten). Jul 1988. 16p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755490/JAW.

Within the scope of the certification of the Aerotech 17PI100 wind turbine the acoustic noise production was measured of the turbine at the wind turbine test station of ECN. The acoustic source power was determined at several values of the wind velocity. The applied measurement method was in close agreement with the ICG report IL-HR-13-01 'Handleiding meten en rekenen industrielawaai'. The immission relevant source power level appeared to be 94.5 dB(A) at a wind velocity at rotor height of 5 to 9 m/s. 3 figs., 7 refs., 1 tab., 1 app.

## 1704 Economics

*REFER ALSO TO CITATION(S) 7694*

## 1705 Environmental Aspects

*REFER ALSO TO CITATION(S) 7687, 7694*

## 1706 Wind Energy Engineering

**7688 (CONF-890102—4) Time domain structural response calculations for vertical axis wind turbines.** Dohrmann, C.R.; Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 23p. NTIS, PC A03 - OSTI. Order Number DE89002185/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

Structural response of Vertical Axis Wind Turbines (VAWTs) during transient events such as starting and stopping or during variable speed operation cannot be estimated with existing frequency domain techniques. Time domain simulation is presented, including the effects of changes in rotation speed on turbine response. The method for predicting the structural response of VAWTs during variable speed events differs from that used to analyze constant speed operation in two ways: (1) the equations of motion no longer have constant coefficients and (2) additional terms contribute to the stiffness matrix and loading vector. The structural matrices are obtained at several discrete rotor speeds using NASTRAN and interpolated for intermediate speeds. The equations of motion are then numerically integrated in a separate program. Results for constant speed operation in turbulence-free winds agree favorable with those from a frequency domain analysis. Reasonable results are obtained for a change in rotor speed which passes through a structural resonance. 3 refs., 9 figs.

**7689 (ECN-PB—88-3) Measurement of the power curve of the Newinco 14PI50 wind turbine at Zurich.** Van der Borg, N.J.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Mar 1988. 16p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755489/JAW.

As a part of the certification procedure of the Aerotech 14PI50 wind turbine of Newinco, the turbine has been tested at Zurich, province of Friesland, Netherlands. The results of the measurement of the power curve are described. The applied measurement and evaluation procedure was in close agreement with the IEA recommendations for wind turbine power performance determination. From the results can be seen that the turbine starts producing electrical power at 10 minutes averaged wind speeds of 5 m/s. For 10-minutes averaged wind speeds between 12.5 and 15.5 m/s the electrical power is about 55 kW. At higher wind speeds the power curve decreases rather fast. The energetic efficiency of the installation is about 39% at wind speeds of 8-9 m/s. The potential annual energy production of the installation is relatively high. 4 figs., 5 refs., 1 tab., 1 app.

**7690 (ECN-PB—88-10) GAPHAT-II, an outlined analysis program for horizontal axis wind turbines (Version 2). Part 2: User's manual.** Schepers, J.G.; Bloemen, H.A. (Netherlands Energy Research Foundation, Petten). May 1988. 44p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755491/JAW.

GAPHAT-II is an ECN (Netherlands Energy Research Foundation) developed computer program which can be used in the pre-design phase of horizontal axis wind turbines. It is applicable for the overall studying of the aerodynamic characteristics, time dependent behavior (f.e. revs, control of the blade angle or security) and the loads in the heart of the blade and the rotor axis. The output data can be presented in a tabular form or as graphics together with the input data. This report discusses the use of the program main section Respons (to calculate the response on a certain wind capacity), and the subsections Rotor and Kracht (Power). 5 refs.

**7691 (ECN-PB—88-14) Power curve determination of an Aerotech 17PI100 wind turbine at the wind turbine test station of ECN.** Van der Borg, N.J.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Oct 1988. 19p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755492/JAW.

With the scope of the certification procedure carried out on the Aerotech 17PI100 wind turbine of Newinco, a specimen of this wind turbine type has been tested at the test station of ECN (Petten). The results of the measurement of the power curve are described. The procedure applied for measurement and evaluation was in close agreement with the IEA recommendations for wind turbine power performance determination. From the results it can be seen that the turbine starts producing electrical power at 10-minutes averaged wind speeds of 4.5 m/s. For a 10-minutes averaged wind speed of 15 m/s the electrical power is about 89 kW. At higher averaged wind speeds the turbine usually produces no electricity. The energetic efficiency of the installation is about 40% at wind speeds of 8 m/s. The potential annual energy production of the installation is relatively high. 5 figs., 7 refs., 1 tab., 2 app.

**7692 (GT—8211) Computer program for aerodynamic analysis of vertical axis wind turbine. Summary report.** (Gas TOPS Ltd., Ottawa, Ontario (Canada)). 1982. 54p. (MICROLOG—88-04465). Canada Institute for Scientific and Technical Information, Montreal Rd., Ottawa, Ont., Canada K1A 0S2; $4.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A computer program for the aerodynamic analysis of vertical axis wind turbines (VAWT) has been developed by the National Research Council of Canada. This program has been designed to provide maximum flexibility and ease of use. It is operated interactively and little familiarity with computers is required of the user for successful running. This document is intended to provide an overview of the program and its capabilities. The program can be used to model any type of vertical axis unit with any number of blades or blade configuration. Blade layout and airfoil section data are required to be input, and the analysis assumes turbine operation at constant rpm in a steady wind condition. Specification of VAWT geometry can be done in dimensional or nondimensional parameters. The basic aerodynamic theory used in the VAWT analysis is a double-multiple streamtube momentum theory which is able to take into account all the main factors affecting VAWT performance, and which is also reasonably simple and therefore fast. This theory is reviewed, along with the coordinate system and discretization scheme used in the computer model. A dynamic stall model is also incorporated. An outline is given of the computer model in terms of system requirements, general organization of the model into modules and hierarchies, data input and output options, procedures for running the program, and other features. 11 refs., 9 figs.

7693 **(NP—9770163) Wind energy converts in electrical power systems. Pt. 2. Large grid-connected WEC's with DC- and AC-link.** Arsudis, D.; Bichler, U.; Ernst, J.; Leonhard, W.; Speckheuer, H.; Vollstedt, W. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Regelungstechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 318p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE89770163/JAW.

Control and behaviour of large turbines operating in wind farms have been investigated in order to control the power transmission similar to hydroelectric power stations in rivers without reservoir. The oscillatory response of synchronous generators on line is a disadvantage for the use in wind-turbines, but new promising solutions for their control are available. By means of a second field winding a smooth transient behaviour can be obtained thus reducing mechanical stresses. Since the operation of synchronous generators on a common d.c. link may be unstable, solutions for stabilizing the system are presented. An extinction angle controller and a constant capacitor combined with a reactive power controller lead to a unity power factor over the whole operating range of the wind energy farm. This variable-speed mode of operation enables each wind turbine to operate with optimal aerodynamic efficiency. Recommendations for the electrical circuit design are given. (orig.) With 174 refs., 182 figs.

7694 **(NYSERDA—88-5) Verification analysis of the toroidal accelerator rotor platform wind energy conversion system: Summary report.** Duffy, R.E. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Sep 1988. 56p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89004094/JAW.

This report describes research undertaken at Rensselaer Polytechnic Institute for the purpose of evaluating the performance, defining the structure and system configurations, and assessing the economic merit of the Toroidal Accelerator Rotor Platform (TARP) wind energy conversion system. The TARP wind energy system is a highly versatile system-design having broad-based application potential ranging from small-kilowatt capacity units to large-megawatt utility-scale power plants. 4 refs., 27 figs., 19 tabs.

7695 **(PB—89-115125/XAB) Yaw control with variable speed: complementary simulations.** Ulen, E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Aug 1988. 20p. (In Swedish). (FOA-C—20728-2.7). NTIS, PC E03/MF A01.

Control of wind-power stations with variable speed and yaw regulation with fixed pitch has been treated earlier. Simulations with values from WTS 1200 have been performed with disturbances as wind turbulence, gusts, changes in wind direction and loss of grid. This report is a complement. Maximum yaw speed and speed of response of the yaw servo was varied. It turns out that maximum yaw speed is important with gusts at nominal windspeed and the yaw servo speed of response is important at higher wind speed. The interaction of thrust on the tower was also been demonstrated.

7696 **(SAND—88-0152C) Three-dimensional wind simulation.** Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 5p. (CONF-890102—9). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003171/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

A method for numerically simulating a three-dimensional field of turbulent wind-speed (the "Sandia method") for use in the aerodynamic and structural analyses of wind turbines is presented. The required inputs are single point power spectral densities (PSDs) and the coherence function. Suggestions for appropriate inputs and an example calculation are included. The simulation method is use to obtain "rotationally sampled" PSDs, which are compared with measurements obtained by Pacific Northwest Laboratories. The results show that the Sandia method is capable of producing simulations that agree with the measurements, especially when the coherence function is augmented from the usual form to include the ratio of spatial separation over height, raised to the 0.25 power. The method is specialized for horizontal axis wind turbine analysis by phase lagging the simulations at each point in space so that wind speeds are simulated only when the turbine blade passes the point, reducing storage requirements and computation time by nearly an order of magnitude. For vertical axis applications, where interpolation will be required, the loss of variance induced by the interpolation is estimated and eliminated by the addition of appropriate white noise. 16 refs., 7 figs., 1 tab.

7697 **(SAND—88-0633C) Initial structural response measurements for the Sandia 34-meter VAWT [vertical axis wind turbine] Test Bed.** Ashwill, T.D. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 22p. (CONF-890102—6). NTIS, PC A03/MF A01 - OTSI. Order Number DE89003133/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

Sandia National Laboratories (SNL) has designed and constructed a 34-meter diameter vertical axis wind turbine (VAWT) Test Bed. The machine will be used to advance research in aerodynamics and structural dynamics, improve fatigue life prediction capabilities, and investigate control algorithms and systems concepts. The Test Bed has extensive instrumentation including 70 strain gauges to measure blade and tower response. Immediately after the blades were mounted, blade gravity stresses were measured and a modal analysis on the stationary rotor was performed to determine zero rpm modal frequencies. Assembly and start-up tests have been completed, and testing is in the machine characterization phase. Resonance surveys are underway to fully characterize the modal frequencies and mode shapes of the rotor, drive train and support cables. Measured gravity stresses, centrifugal stresses, and modal frequencies are compared to predicted values. 11 refs., 12 figs., 1 tab.

7698 **(SAND—88-1774C) Model validation of the Sandia 34-Meter Test Bed Turbine using substructure modal-testing.** Carne, T.G.; Lauffer, J.P.; Gomez, A.J.; Ashwill, T.D. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 6p. (CONF-890102—11). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004040/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The Sandia 34-Meter Test Bed Turbine is a vertical-axis wind turbine, thirty-four meters in diameter, designed to provide a test-bed for research in aerodynamics, structures and control. In order to design a large wind turbine, knowledge of the modal frequencies and mode shapes is essential for predicting structural response. During the design, analytical or finite element models are utilized for estimates of these modal parameters. However, when hardware becomes available, modal testing can be used to verify or update the models. The concept of substructure modal testing was developed for the Sandia 34-Meter Test Bed in order to more fully evaluate the accuracy of the finite element model. Instead of performing only one test on the entire turbine, separate tests and analyses were performed on major substructures of the turbine, including three separate blade sections, the tower supported by the guy cables, and the entire turbine. The results were then compared to analytical predictions from the finite element models of the substructures and the entire turbine. 8 refs., 6 figs., 6 tabs.

7699 **(SAND—88-1806C) Simplified fatigue damage and crack growth calculations for wind turbines.** Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 21p. (CONF-890102—7). NTIS, PC A03/MF A01 - OSTI. Order Number TI89003132/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

Estimating fatigue life of wind turbine components, where the loading and structural response are random, can be a difficult task. The life estimate is sensitive to rare large loads and can be

influences by the sequence of load applications. Sequence effects in fatigue crack initiation and crack growth are outlines. A simplified model for sequence effects in crack growth is presented along the model predictions of an American Society for Testing and Materials (ASTM) crack growth test series. The relative importance of including these effects in fatigue calculations is discussed. Analytical solutions for the time to crack initiation and crack growth provide quick estimates of fatigue life by approximating the loading as a narrow-band Gaussian process and by neglecting sequence effects. This approximation is both conservative and within the usual scatter in fatigue life estimates due to material variability. It is therefore a useful tool in estimating fatigue life especially when turbine response data are limited. 24 refs., 5 figs.

7700 **(SAND—88-1942C) Crack propagation analysis of WECS [wind energy conversion system] components using the LIFE2 computer code.** Sutherland, H.J.; Schluter, L.L. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 11p. (CONF-890102—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89001690/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The LIFE2 code is a fatigue/fracture analysis code that is specialized to the analysis of wind energy conversion system components. It is a PC-compatible FORTRAN code that is written in a top-down, modular format. This paper discusses the additions to the code that permit WECS components to be analyzed using linear fracture mechanics. To illustrate the capabilities of the numerical techniques employed here, two example problems are presented. 8 refs., 7 figs.

7701 **(SERI/TP—217-3423) A comparison of results from dynamic-response field tests.** Hock, S.M.; Thresher, R.W.; Wright, A.D. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1988. Contract AC02-83CH10093. 7p. (CONF-890102—10). NTIS, PC A02/MF A01 - OSTI. Order Number DE89000820/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The dynamic response of Howden's 330-kW horizontal-axis wind turbine (HAWT) and the Northern Power Systems 100-kW "North Wind 100" HAWT has been measured. The Howden machine incorporates a 26-m-diameter, upwind, three-bladed, wood/epoxy rotor that operates at 42 rpm and is a rigid-hub design. The North Wind 100 rotor has a diameter of 17.8 m, is upwind, two-bladed, and constructed of fiberglass, and has a teetered hub. The Northern Power turbine's blades are fully pitchable, while the Howden machine uses pitchable blade tips. This paper will present the results from each of these test programs in an effort to compare the dynamic response of each turbine. The analysis will focus on rotor bending loads in terms of both time domain and frequency response. The FLAP code will be used to explore sensitivity to teeter stiffness and natural frequency placement to provide a better understanding of the differences in behavior caused by configuration alone. The results are presented in the form of normalized azimuth-averaged plots of the deterministic loads, and spectral density plots of the stochastic responses. This presentation of the results will contrast major response differences due to design configurations. 6 refs., 19 figs., 3 tabs.

# 20 ELECTRIC POWER ENGINEERING

*REFER ALSO TO CITATION(S) 7773, 7914, 7949, 7952*

7702 **(CRIE-U—87017) Preliminary experiments on the growth of plants exposed to DC corona discharge in a hydroponics.** Shigemitsu, Tsukasa; Watanabe, Yasunori. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 45p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755713/JAW.

For the purpose of utilizing electrical phenomena to agriculture fields, preliminary experiments were carried out hydroponically to evaluate especially the effects of ion by DC corona discharge on the growth of plants such as lettuce or radish. The influences of various shapes of discharge electrodes on a water evaporation rate, ozone production rate and ion current change were studied, and the indirect stimulation effects on plants by more water evaporation under discharge, and the direct stimulation effects on plants with discharge by the electrode fixed 45cm above plants were studied. As a result, the water evaporation rate was 2 or 3 times more than that of control plots by positive or negative corona discharge, however, for the growth of plants, no remarkable direct or indirect stimulation effects by discharge were observed. As subjects, the clarification of water behavior change under discharge and of effects on plants in cellular level were pointed out to be necessary. (14 figs, 12 tabs, 12 refs)

7703 **(EPRI-EL—6126) Induction motor modeling in stability simulation: Final report.** Carlson, D.L.; Fedora, C.M. (Electric Power Research Inst., Palo Alto, CA (USA); Minnesota Power and Light Co., Duluth (USA)). Dec 1988. 48p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004385/JAW.

The objective of this project is to help utilities choose models of large motor loads when simulating electric system transient stability behavior during severe contingencies. Various motor models were evaluated through comparisons between simulations and field recordings obtained in this project. Guidelines are developed to assist engineers in applying typically available data describing large motors. 10 refs., 35 figs.

## 2001 Power Plants And Power Generation

*REFER ALSO TO CITATION(S) 7200, 7210, 7213, 7214, 7215, 7216, 7286, 7923, 7972, 7972, 8207*

7704 **(CRIE-U—87043) Field survey on the warm water diffusion in stratified marin environment.** Mizutori, Masafumi; Katano, Naoaki; Kadoyu, Masataka; Soga, Masami. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755716/JAW.

The stratified environment is formed in the sea around coastal power plants, which a lot of river water flow into. It is known that the characteristics of warm water diffusion in such environment are different from them in unstratified environment. The field surveys were carried out once a year in 1984 and 1985 to grasp the mechanism of warm water diffusion in such environment, and to advance the present prediction model, at two sea areas observed clear effects of river water in front of the water outlet of existing power plants. The following results were obtained. It was shown that remarkable stratified environment caused on decrease in surface distribution area of warm water. The vertical patterns of warm water diffusion are able to be divided into four types. There are the Front areas, where water temperature changes suddenly, in the boundary of warm water and river water distributions. Density structure arround the Front areas was analyzed, and some characteristics such as complicated shapes of vertical distribution of water temperature and salinty and others were grasped. (22 figs, 2 tabs, 2 refs)

7705 **(CRIE-U—87061) State of water quality in bay and technical problems in near future.** Matsunashi, Shiro; Katano, Naoaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1988. 58p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo. Order Number DE88755726/JAW.

The water quality in a bay gets worse remarkably due to the concentration of a population and increase of industrial activities. Many power plants are located facing the bay and depend on the sea area for taking of cooling water. As typical example of the bay, Tokyo bay was selected and the published data on the water quality in the bay were surveyed. A characteristic and seasonal distribution of temperature, in which a temperature difference between upper layer and lower layer becomes 6 to 7°C in summer, was

shown. Yearly variation of COD shows slightly increase, however, it becomes worst in summer. Dissolved oxygen is high level in upper layer at the interior of the bay, meanwhile, in lower layer it becomes poor oxygen condition with 3 ppm and less. As for previous prediction model on water quality, there are several problems to be improved hereafter in respect of rationality and universality on the coefficients which indicate quantitative relation among water qualities. As for the indexes which indicate water quality characteristics, wide area's indexes have been investigated, such as an index for sea water exchange, a parameter for water quality. However, it is required to reconsider the indexes for local sea area where is affected by water-intake, drainage and others. (45 figs, 31 tabs, 33 refs)

7706 **(CRIE-Y—8801) Development of a load analysis system for load management.** Ono, Kenji; Sagai, Shigeo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1988. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755730/JAW.

The Central Research Inst. of Electric Power Industry has developed a load analysis system for load management. With the spreading of cooling and heating equipment, the load factor (the ratio of the average power load to peak load) is gradually decreasing. This is increasing the need of the optimal demand characteristics for efficiently using equipment, including load equalization. This system allows an operator to understand the demand load curve, analyze factors of load fluctuations, and examine the results displayed graphically. The system (1) efficiently stores a large amount of load data, meteorological data, and auxiliary information; (2) uses a clustering method to allow the operator to classify daily consumer load patterns and estimate load patterns according to the use; (3) allows the operator to easily display daily and annual load curves graphically; and (4) allows the operator to classify the average daily load curves for the 12 months in a year by using the clustering method and elucidate the cause of load fluctuations in relation with consumer attributes. The Center has also developed a model of estimated load shapes classified by the usage based on the load data and load equipment data of each consumer classified by the type of occupation (for small-scale industries only). This model reflects the reality well. (10 figs, 4 refs)

7707 **(CRIE-Y—87009) Analysis of system thermal efficiency on thermal power plants. Introducing effects of combined cycle system.** Nagata, Yutaka; Uchiyama, Yoji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1988. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755733/JAW.

The system thermal efficiency (STE), represented an avaraged efficiency of thermal power plants which belong to the same electric power system, affects significantly fuel consumption of thermal power generation. This report provides a developed simulation model to forecast the STE, and the improvement of STE by introducing combined cycles is calculated to analyze market penetration between the conventional and advanced technologies in Japanese electric utilities. The result shows clearly that the introduction of combined cycle will increase the STE at the end of fiscal year 2015 up to 42.1 % in the standard case; 10 % higher than one in case without any combined cycle. As a result of sensitivity analysis, it is important to improve the upper limit of plant utilization factor and to develop technologies and promote positively the introduction of the combined cycle power generation plant. In the sensitivity analysis, an introduction speed and a plant effeciency of the combined cycle are quantitively investigated and it becomes clear that the changes of capacity factor has little influence on the improvement of STE. (24 figs, 6 tabs, 6 refs)

7708 **(DOE/BP/63056—1) Development of combustion turbine capital and operating costs.** (Fluor Daniel, Inc., Irvine, CA (USA)). Oct 1988. Contract AM79-86BP63056. 81p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004410/JAW.

This study is a continuation of a series of evaluations of the costs and technical performance of various generation technologies. BPA published the first of the series in 1983 and has continued with annual updates since that time. Information from these studies has been useful to BPA, the Pacific Northwest Electric Power and Conservation Planning Council (Council) and others in the region. It has been useful in efforts to plan and secure future generation and as a screening tool to aid in prioritizing research and development programs for promising new generation technologies. This report presents cost and performance data for the phased development of a combined cycle generating station. A phased construction approach was assumed to demonstrate an approach to adding a new capacity as needed. Initially a gas turbine burning natural gas is installed, followed by a second gas turbine one year later. A Heat Recovery Steam Generation system and a steam turbine is then added to complete the combined cycle plant. The study was performed by Fluor Daniel, Inc. under contract to BPA. The study is meant to be generic in nature. Boardman has been used as the example site as it was in all previous studies. The General Electric Model MS7001F gas turbine was chosen to represent the next generation of gas turbine available to the utility industry. Section 7 of this report contains an assessment of developing combustion turbine technologies. 4 refs., 10 figs., 19 tabs.

7709 (EMR/MB—RFC72/95-CCRL, pp 25-30) **Practical aspects of applying coal-in-oil to power generation and industry.** Featherby, S.F. (Ontario Hydro, Toronto). Dec 1973. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-7205129—; CE—01973).

From Coal-in-oil seminar; Ottawa, Canada (17 May 1972).

The use of coal in Ontario power generation has been limited to coal from the USA and subsidized coal from the Canadian Maritime provinces; coal from western Canada has not been used because of the long distance involved, with high transport costs. This coal could be used, however, if pipelined along with western crude oil. The solids could be separated by cyclone and burned in boilers, or the slurry could be burned directly in a cyclone furnace. Some advantages would be the prospect of reducing the ash collecting and disposal problem, greater security of supply, and less need for coal stockpiles (since the pipeline could supply year round). To avoid hazards and complications due to the naphtha fractions in the crude oil, the lighter fractions could be taken off in local refineries and the heavier oil could continue as the carrier of the coal to the furnace.

7710 **(EPRI-CS—5588-Vol.1) Remaining life estimation of boiler pressure parts: Volume 1, Identification of relevant damage mechanisms: Final report.** Ellis, F.V.; Henry, J.F.; Roberts, B.W.; Askins, M.C.; Shammas, M.S.; Cane, B.J. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Chattanooga, TN (USA)). Nov 1988. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004096/JAW.

As part of EPRI Research Project 2253-1, "Remaining-Life Estimation of Boiler Pressure Parts," one of the program's principal objectives was the identification and characterization of the relevant damage mechanism in elevated temperature headers and steamlines. Described herein are the results of work undertaken at Combustion Engineering and the Central Electricity Research Laboratories (CERL) in fulfillment of that task. Conclusions regarding the range of operating conditions to which headers are exposed, the typical damage mechanisms that affect their service lives, and the anticipated modes of failure have been based on information obtained from three sources: (1) a comprehensive survey of utilities, (2) extensive on-site examinations of operating components, and (3) laboratory analyses of samples removed both from headers retired from service and from headers still in operation. 32 refs., 72 figs., 9 tabs.

7711 **(EPRI-EL—6125) Concurrent computation of power system reliability: Final report, December 1988.** Boratynska-Stadnicka, D.J.; Van Ness, J.E. (Electric Power Research Inst., Palo Alto, CA (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science). Dec 1988. 81p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004247/JAW.

SYREL is a computer program which finds the upper and lower bounds on the reliability indices for an electric utility system. It tests a list of contingencies for violations of line loadings or voltage limits, and then uses the results from that to compute the reliability indices by a tree search. Most of the time in the computation is taken by these two parts, the contingency evaluation and the tree search. These two parts of the program have been modified to run on a hypercube computer. Using 16 processors the program ran up to 14.7 times faster than with a single processor. A major change that had to be made in the program in order to utilize the capability of the hypercube was to move the storage of the contingency evaluation results that would be used in the tree enumeration from the disk to the large memory available in each node. This project served as a test of the feasibility of using hypercube computers for electric utility system problems. The experiences in converting a large production code to concurrent computing can serve as a guide to other such projects. 4 refs., 26 figs., 11 tabs.

7712 **(EPRI-EL—6138) Static electrification in Refrigerant 113: Final report.** Devins, J.C.; DeVre, M.W. (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Dec 1988. 175p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004856/JAW.

This report describes a one year effort to determine the fate of an Ionic additive, DCA-48, in Freon TF ($C_2F_3Cl_3$), used to cool the thyristors in a compressed gas-insulated converter station, under the action of a dc voltage. The additive is present to increase the conductivity of the TF and prevent static charge buildup during flow. The primary objective was to understand the time dependence of the additive loss, and then explain departures from Faraday's law, determine whether electrolysis would lead to corrosion, and determine whether conductive films would form on insulators. A combination of kinetic studies of conductivity changes, together with the application of a large number of analytical techniques has led to a model which explains most of the observations. These include the departure from Faraday's law, transient conductivity changes, conductivity recovery rate after voltage removal, and the effects of electrolysis on all of these. A key element in this model is the formation of a waxy film on the electrodes which appears to allow the intermediate species produced at the electrodes by electrolysis to reform the original additive. Of the three electrode materials studied, aluminum, stainless steel, and copper, only the latter seems to enter into the reaction and appears in solution. However, the efficiency is sufficiently low so that no major problem is expected. Any films produced on either Tefzel or glass-epoxy insulators have immeasurably low conductivity. Scaling up to laboratory results to the HVDC converter station at Astoria suggests that the transient conductivity drop due to reduction in ion concentration by the sweeping-out effect of the applied field is expected to be negligible. The depletion of additive due to electrolysis is expected to be less than 15% during the first year and to decrease in rate with time. 5 refs., 94 figs., 6 tabs.

7713 **(EUR—10951) Esther loop. Operation report. First results.** Durin, M.; Goldstein, S.; Lamoureux, M.; Le Sech, A.; Souletie, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). (Commission of the European Communities, Luxembourg). 1987. 36p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756033/JAW.

CEA investigated the technical feasibility of a topping cycle with sulfur as a working fluid (600-750/sup 0/C) in combination with a conventional steam cycle for the production of electricity. The overall energy conversion efficiency is estimated to be 60%. This investigation will use an experimental installation to study the properties of sulfur as a working fluid in a high-temperature thermodynamic cycle. The programme included the design, construction and operation of this installation. Above 400/sup 0/C the experimental data available are unreliable. CEA established the required data for the properties of sulfur at high temperatures (up to 800/sup 0/C). There are technical difficulties in the construction of the main loop and preliminary tests were necessary. The problem of corrosion of steel by sulfur at high temperatures had been solved previously (internal protective coating of alumina). CEA also tested the corrosion of small components under real plant conditions in a special loop. To better estimate pressure drops and heat transfer coefficients, experiments have been carried out in a test rig. The main loop was designed in detail and constructed and preliminary tests have been carried out.

7714 **Wet peat power processes: A thermodynamic study.** Lyngfelt, A.; Stenberg, P. (Dept. of Energy Conversion, Chalmers Univ. of Technology, 412 96 Goteborg (SE)). *Journal of Engineering for Gas Turbines and Power;* **110**: No. 2, 155-160(Apr 1988).

The efficiencies of four power processes for wet peat have been studied. These include gas turbine cycles, steam power cycles, and combinations thereof. It is concluded that wet peat can be used in power processes with reasonable efficiency. The paper suggests that wet peat power processes could be cost competitive relative to conventional power production.

## 2002 Environmental Control Technology

*REFER ALSO TO CITATION(S) 7199, 7243, 7244, 7247, 7282, 7704, 7705, 7735, 9155, 9165, 10428*

7715 **(DOE/PC/91022—T3) Acoustic agglomeration of power plant fly ash: Quarterly technical report, November 5, 1986--February 5, 1987.** Reethof, G. (Pennsylvania State Univ., University Park (USA). Noise Control Lab.). 20 Mar 1987. Contract AC22-86PC91022. 69p. (PSU-ME-R—86-87-0031). NTIS, PC A04/MF A01 - OSTI. Order Number DE89001472/JAW.

The objective of this project is to complete the investigations on the use of high intensity acoustic energy to agglomerate micron and submicron sized particulates in fly ash aerosols in order to provide the necessary scientific knowledge and design criteria for the specification of technically and economically viable intermediate flue gas treatment of coal fired power plants. The results of the project are to provide technical and economic information for the better development and evaluation of potential fine particulate control systems. The goals of the proposed work are to further the understanding of certain fundamental processes by means of theoretical and experimental investigations, to include this knowledge in an advanced computerized model of the agglomeration processes. Tests with the two acoustic agglomerators available in Penn State's new High Intensity Acoustics Laboratory will be used to verify the results from the agglomeration simulation. Research work will continue on high power, high efficiency sirens with special emphasis on the nonlinear acoustic phenomena and novel means of significantly increasing siren efficiency. A study will be carried out to evaluate the economics of conventional coal fired power plant clean-up systems using acoustic agglomerators as intermediate flue gas treatment.

7716 **(PB—88-245915/XAB) Rate controlling processes and enhancement strategies in humidification for duct $SO_2$ capture. Final report, November 1986-July 1987.** Moyeda, D.K.; Newton, G.H.; La Fond, J.F.; Payne, R.; Kramlich, J.C. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1988. 131p. NTIS, PC A07/MF A01.

This report gives results of an investigation of the fundamental rate processes that govern sulfur capture in power-plant ducts during humidification of flue gases. The specific application was the reactivation of partially sulfated calcium-based sorbents from in-furnace injection. The results suggest that physical contacting between the spray water and the sorbent particles is necessary to achieve significant reaction rates. Several ways to promote such contacting were investigated, and a general approach to contacting was proposed. These hypothetical predictions were tested in a subscale rig using laser-based measurements. The reactivity of slurry drops was investigated in a dilute-phase reactor. The results indicate that calcium availability (i.e., dissolution into the liquid) and droplet lifetime were the principal constraints on sulfur capture.

7717 **(PB—88-250212/XAB) Activation and reactivity of novel calcium-based sorbents for dry $SO_2$ control in boilers. Report for October 1986-July 1988.** Jozewicz, W.; Kirchgessner, D.A. (Acurex Corp., Research Triangle Park, NC (USA)). Aug 1988. 19p. NTIS, PC A03/MF A01.

Chemically modified $Ca(OH)_2$ sorbents for $SO_2$ control in utility boilers were tested in an electrically heated, bench-scale isothermal flow reactor, operated at between 700 and 1000 C and residence times of from 0.6 to 2 sec calculated from bulk-gas flow rates. Novel surfactant-modified $Ca(OH)_2$--SM-$Ca(OH)_2$--sorbents were compared to conventional $Ca(OH)_2$ produced by dry hydration, DH-$Ca(OH)_2$. Sorbents were activated in the flow reactor. Changes in the pore structure of $Ca(OH)_2$ sorbents reacting with $SO_2$ also were investigated. The effect of thermal sintering on pore structure of sorbents reacting with $SO_2$ was eliminated. The degree of conversion was controlled by varying gas-phase mass-transfer resistance ($SO_2$ concentrations from 50 to 3000 ppm).

7718 **(PB—88-251772/XAB) Performance/cost estimates for retrofitting control technologies at 12 coal-fired power plants.** Jones, J.W.; Emmel, T.E.; Laseke, B.A. (Radian Corp., Research Triangle Park, NC (USA)). 1988. 7p. NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 38, No. 6, 852-856(Jun 1988).

This paper gives results of estimating performance/costs of retrofitting pollution-control technologies at 12 coal-fired power plants. In cooperation with the states of Ohio and Kentucky (in conjunction with EPA's state acid-rain program), efforts were undertaken to visit and conduct detailed evaluations of 12 coal-fired plants--5 in Ohio and 7 in Kentucky and the Tennessee Valley Authority system. A variety of commercial and advanced $SO_2$ and NOx control technologies--including precombustion, combustion (in-furnace, and post-combustion (flue gas cleanup) technologies--were applied to each plant through conceptual designs. Retrofit factors (applied to the capital cost of a new pollution control system), cost adders (e.g., movement of existing equipment), and costs were developed for applying the control technologies to the boilers of each plant. Results of these and subsequent efforts will be valuable in evaluations of acid deposition control strategies by federal and state agencies and by electric utilities.

7719 **(PB—88-251780/XAB) SOx out on a LIMB (Limestone Injection Multistage Burner).** Drehmel, D.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1988. 6p. (EPA—600/J-88/126). NTIS, PC A02/MF A01.

Pub. in Modern Power Systems, 73, 75, and 77(May 1988).

This paper describes the most-recent results from the Limestone Injection Multistage Burner (LIMB) program, covering results from the wall-fired demonstration. Tests were conducted to determine the efficacy of commercial calcium hydroxide ($Ca(OH)_2$) and of calcium-lignosulfonate-modified $Ca(OH)_2$. Performance of the modified sorbent was slightly better than that of the commercial sorbent. Both sorbents easily provided 50% capture of $SO_2$ at a calcium-to-sulfur molar ratio of 2.0 or less, which is the goal of the LIMB program. The paper also lists the major conclusions from the LIMB program to date.

7720 **(PB—89-101208/XAB) Advanced Utility Simulation Model documentation of system design: state-level model (Version 1.0). Final report, September 1980-August 1985.** Badger, C.J.; Ojalvo, H. (Illinois Univ., Urbana (USA). Coll. of Engineering). Aug 1988. 149p. NTIS, PC A07/MF A01.

See also PB—88-204268.

This report is one of 11 in a series describing the initial development of the Advanced Utility Simulation Model (AUSM) by the Universities Research Group on Energy (URGE) and its continued development by the Science Applications International Corporation (SAIC) research team. The AUSM is one of four stationary-source emission and control-cost forecasting models developed by EPA for the National Acid Precipitation Assessment Program (NAPAP). The AUSM projects air-pollution emissions ($SO_2$ and NOx), generating-technology types and costs of operation, and combinations of fuels and emission-control technologies to simultaneously meet electric demand and emission constraints on a least-cost basis for each year through 2010. Thirteen electric-demand regions are simulated, and output is provided for each of the 48 states. The initial version of AUSM, designated Version 1.0, was delivered by URGE in November 1984 and August 1985. Further development of the AUSM by SAIC between 1985 and 1988 has resulted in the development of Versions 2.0 and 3.0. Reports describing these revisions by SAIC to the initial Version 1.0 of AUSM are also part of the series.

7721 **(PB—89-102784/XAB) Gas Reburning-Sorbent Injection (GR-SI): development status and field evaluation plan. Topical report, September 1986-August 1987.** Bartok, W.; Folsom, B.; Lanier, S.; Payne, R. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1987. 63p. NTIS, PC A04/MF A01.

This report reviews the technical basis for Gas Reburn-Sorbent Injection (GR-SI) technology for NOx/SOx control using a combined technology in which NOx is controlled from coal-fired boilers by the replacement of a portion of the coal feed by natural gas. The natural gas is injected in a manner that yields a chemical NOx reduction. Calcium based sorbents are injected into the upper furnace to absorb $SO_2$. An added benefit of natural gas reburning is the reduction in the mass of ash that is imposed on the boiler. The results of extensive subscale tests are reviewed to provide a current overview of the technical basis for GR-SI. At present, natural gas reburning can be optimized to yield at least a 60% NOx emission reduction. The optimized injection of calcium hydroxide will easily capture at least 50% of the $SO_2$. The report concludes by reviewing demonstration plans at the three Illinois power plant sites.

7722 **(PB—89-102826/XAB) Extended development of gas cofiring to reduce sulfur dioxide and nitric oxide emissions from a tangentially coal-fired utility boiler. Topical report, August 1987-February 1988.** Booth, R.C.; Glickert, R.W. (Energy Systems Associates, Pittsburgh, PA (USA)). Aug 1988. 125p. NTIS, PC A06/MF A01.

A field experiment was conducted on a 570-MW coal-fired boiler to investigate the application of gas cofiring to reduce nitric oxide and sulfur dioxide emissions. Testing documented that a 25% reduction in nitric oxide (NOx) emissions could be achieved by biasing fuel to the lower furnace and reducing the excess oxygen concentration. Approximately 6 to 10 percent gas was cofired in order to reach the optimized bias condition. Cofiring natural gas ignitors resulted in reductions in the emission of sulfur dioxide which were greater than the percentage of gas heat input in fifteen of the twenty tests that were conducted. Sulfur dioxide reductions ranging from 1 to 12 percent were documented when firing 1 to 3 percent natural gas. The results indicate that gas fired in the upper furnace region has greater influence over sulfur dioxide reduction. An investigation was made into the mechanism which controls the apparent retention of sulfur.

7723 **(PB—89118749/XAB) Advanced Utility Simulation Model. Model operations (Version 1.0). Final report, September 1980-August 1985.** Badger, C.J.; May, W.H. (Illinois Univ., Urbana (USA). Coll. of Engineering). Oct 1988. 138p. NTIS, PC A07/MF A01.

See also PB—89-101208.

The report is one of several in a series describing the initial development--by the Universities Research Group on Energy (URGE)--of the Advanced Utility Simulation Model (AUSM), one of four stationary source emission and control cost-forecasting models developed by the U.S. EPA for the National Acid Precipitation Assessment Program (NAPAP). The AUSM model projects air pollution emissions ($SO_2$, NOx, and particulate matter), costs of electric generation, electric rate schedules, costs of emissions control, fuel consumption by type, electric generating technology construction, and generating technology utilizations (i.e., capacity factors) for existing and new electric-utility-generating units by state. The particular report describes the methodology employed to run the model as it was initially developed (Version 1.0). The changes to the methods of operation of the AUSM model (i.e., the AUSM as revised by the Science Applications International Corporation

(SAIC) research team to produce Version 3.0) are described in another report in the same series.

## 2003 Power Transmission And Distribution

*REFER ALSO TO CITATION(S) 7693, 7711, 9595, 9596*

**7724 (CRIE-T—86069) Protection and control method by using online data on distribution system(part 1). Feature and function of method.** Inoue, Yukio; Miyauchi, Motomitsu; Yukihira, Kenji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755699/JAW.

In conventional practice, the inspector detects an accident-affected section after cutting the accident-affected distribution line by using a substation relay system. The disadvantage of this method is that it entails the power interruption of the sections in a normal state for a short period (up to several minutes). The Electrical Power Research Center has developed a control and protection system for detecting an accident-affected section by using online accident data on the distribution system and coping with single-wire grounding without interrupting the power supply to the unaffected sections. Substation relay elements are used to instantaneously detect the type of accident and its feeder. The direction of grounding is checked by and transmitted from the switch terminals and is used to detect the accident-affected section. The load-side distribution line in the accident-affected section is looped with another distribution line to secure supply force. The accident-affected section is then determined. The possibility of realizing this system has been confirmed by tests in the Akagi Laboratory. This system can protect the electric system from a single-wire grounding, limit the power interruption time in a short-circuit to a moment, and allow workers to detect a transitional failure (less serious than a trip), thus facilitating accident prediction. (16 figs, 5 refs)

**7725 (CRIE-T—87015) Characteristics of AC superconducting coils (Part 1). Quenching.** Akita, Shirabe; Ishikawa, Tadao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 50p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88755702/JAW.

As a part of the development and evaluation of AC superconductor for various applications to power equipments, three winding types of superconducting coils (capacity: 20 and 500kVA) were made of NbTi superconductor as an experiment. As a result, in case of AC current, it was especially important to prevent mechanical temperature rise by rigid fixing of the coils, otherwise AC quenching current lowered remarkably compared to DC quenching current with increasing of temperature and in extreme case fell to a half value of DC current. The training phenomenon of AC superconducting coils occurred by the same cause as DC current. The quench propagation velocity of AC superconducting coils was possible to calculate accurately using the modified DC quenching analysis method substituted R.M.S. values of AC current for DC current values. Since AC superconducting coils included less stabilizing copper, winding temperature reached occasionally to 100K or more at quenching. (35 figs, 4 tabs, 8 refs)

**7726 (CRIE-T—87020) Approximate calculation of electrostatic field under AC overhead transmission lines.** Amano, Yuji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 27p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88755703/JAW.

Simple approximate equations were proposed to estimate accurately the maximum electrostatic field value at 1m above the ground level under AC vertical double circuit transmission lines of low-reactance phase arrangement or one circuit energized on double circuits arrangement. Following parameters were used; V:voltage between phases, H:hight of lower phase conductor, C:mean vertical phase spacing, W:mean horizontal phase spacing, Re:conductor radius or equivalent radius. By comparing analysis values by a large scale computer with values calculated by these equations, a very high accuracy was confirmed with calculation errors of +-3% or less in the range of 187-1,100kV. They were also applicable in the range of C/W = 0.3-0.7 or W/H = 0.6-1.3 for multi-conductor transmission lines, so that involved enough the range for commercial lines. The equations were considered to be useful to estimate the influence of parameters in a design or the effect of phase spacing reduction on hight reduction of conductor in a insulation design. (21 figs, 4 tabs, 4 refs)

**7727 (CRIE-T—87026) Generalization of phase-to-phase switching impulse flashover characteristics estimation.** Aihara, Yoshinori. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1988. 48p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88755705/JAW.

The phase-to-phase flashover characteristics are affected by many parameters. The phase-to-phase flashover voltages estimation has been investigated under the test results obtained at home and abroad. The phase-to-phase flashover voltages of long air gaps can be estimated with the parameters of alpha m (The ratio of negative peak voltage to positive plus negative ones), delta t (The time shift between negative and positive voltages), T/sub/t/(The time-to-half value on tail of negative voltage) and V (The phase-to-ground flashover voltage of positive polarity). The phase-to-phase flashover voltage is affected by the electode capacity and a closed object due to a gap arrangement, however, it can be calculated correctly by giving the phase-to-ground flashover voltage of positive polarity. In the case of alpha m of 0.5, which is expected as usual figure in surge at real transmission line, and delta T of O, the phase-to-phase flashover voltage is estimated as a function of gap spacing. (25 figs, 2 tabs, 19 refs)

**7728 (CRIE-T—87027) Analysis of phenomena at paralleling between power systems by AC-DC power system simulator.** Jojo, Katsumasa; Taniguchi, Haruto; Asada, Minoru; Kitauchi, Yoshihiro; Tamura, Shinji; Hioki, Eiji; Fujita, Hideki; Yamada, Masaru; Matsumoto, Hiroyuki; Okumoto, Yoshiharu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 52p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88755706/JAW.

In order to find exactly the permitted difference limits of phase, frequency and magnitude of voltage between both power systems in cases where a separated power system was reparalleled to a trunk transmission line, fundamental experiments were carried out on a simple power system using AC-DC power system simulator, and the results were compared with analysis results by the existing computer simulation method to verify the validity of the computer method. As a result, paralleling stability limits were greatly affected by the difference of phase or frequency between both systems, and a stability range increased with decreasing frequency on the side of a generator and decreased with increasing generator output, and a large positive phase difference had a significant effect on system fluctuation. In the case of large frequency differences, the paralleling stability limits differed slightly between both sumulation methods, and the paralleling fluctuation phenomena differed slightly between both methods at an early stage, however, both methods were confirmed to well agree. (37 figs, 4 tabs, 2 refs)

**7729 (CRIE-T—87030) Breakdown characteristics of a gas mixed with liquid mist. Evaluation of breakdown strength under quasi-uniform fields.** Yashima, Masashi; Fujinami, Hideo; Takuma, Kaoru. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 43p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755708/JAW.

In order to clarify the breakdown characteristics of a gas mixed with liquid mist, flashover voltages were measured when $N_2$ or $SF_6$ gas was mixed with $C_2Cl_4$ mist and influence of gas pressure, applied voltage and horizontal and vertical gap arrangements was studied. Increase rate of breakdown strength due to mist mixture was evaluated from these results and their factors were investgated. The increase rate of breakdown strength was significant for the voltage of shorter duration such as lightning impulse voltage but was not so remarkable under dc or ac. The mist density may decrease due to the electrostatic force between mist adhered on the electrode surface and the gap under applied dc or ac voltages. The major factor on the increase of breakdown strength is considered

attributable to the lengthened statistical time lag in discharge due to the scarcity of initial electrons. (18 fig, 2 tabs, 22 refs)

7730 **(CRIE-T—87031) Performance estimation of digital systems in the presence of power transmission line interference.** Serizawa, Yoshizumi; Takeshita, Kazumaro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo. Order Number DE88755709/JAW.

The calculating method of error rate characteristics in the presence of power transmission line interference was developed for digital radio system. Amplitude and phase distorted characteristics of received signal due to an interfering wave reradiated by a power transmission line was calculated when a transmission line intersected a digital radio propagation path, and the method to calculate the error rate performance was developed by using a series expansion method. The equivalent C/N degradation (carrier to noise ratio) at any error rate due to power transmission interference can be evaluated. The interference by itself path was calculated when 7.5GHZ 16QAM 32Mb/s system crossed a bundle of conductors. It was shown from the results that the performance degradation of digital radio system was more serios than the screening loss of analog systems because of addition of amplitude and phase distorted characteristics in the transmission band. On the other hand, the conventional D/U (desired to undesired) signal ratio can be applied for the another radio system interference. (13 figs, 9 refs)

7731 **(CRIE-T—87032) Construction LAN system for electrical substation.** Kurono, Masahiro; Kameda, Hideyuki; Tsuboi, Akira. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755710/JAW.

In this paper, the authors propose an optical-fiber-type LAN system for electrical substations. This system uses nodes arranged in each line to take field data for protection and control and employs a token-ring transmission system to transmit such data. The proposal pertains to a method of collecting field data necessary to execute protection and control functions by using the nodes and a method of sampling synchronization. As an additional function of the nodes, the authors propose a reliability monitoring method based on the mutual comparison of field data for protection with that for control. To realize the time-fixed transmission and simultaneous transmission of sampling synchronous signals, the authors propose methods of using the broadcast transmission function at the transmitter side and the transmission-inhibiting function at the receiver side. To compensate sampling synchronous error, the authors propose multi-frame transmission and receiver-side clock and proved that it works well with regard to protection operations precision. (8 figs, 10 tabs, 13 refs)

7732 **(CRIE-T—87039) Preliminary survey of integrated monitoring system for transmission liens.** Sasano, Takao; Nishiyama, Fumihiko. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755711/JAW.

The integrated monitoring system of transmission lines utilizing ground wire with built-in optical fibres(OPGW) which was put to practical use was surveyed. The overhead transmission lines have potential to be impeded supply owing to the line exposure to severe natural envioronment or by the change of surrounding environment such as trees, buildings under lines and ground or by deterioration of equipments. This report describes the system to monitor integrally the transmission lines by using OPGW or sensor technology to maintain and operate with higher reliability and lower cost and to reflect in the design, except the conventional maintenance and checking. The effect to foresee and prevent accidents is expected from this system, but the regional difference must be considered. This system can provide continously reliable monitoring, collection of maintenance informations and operation support and further can provide accident informations to be used in the design through the evaluation. It is necessary to use highly reliable repeaters for optical informations, protect instruments under intense field, prevent malfunction and develop the auto-movable robot for taking picture and local weather prediction system in order to realize this system. (5 figs, 6 tabs, 8 refs)

7733 **(CRIE-T—87041) Flashover characteristic of air gaps by lightning impulse voltage with short tail.** Aoshima, Yoshihide; Miyake, Kunihiko. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755712/JAW.

The flashover characteristics of air gaps by short tail lightning waves (2.8 to 40 micro s) were described, in order to contribute to analysis of lightning back-flashover outages and insulation design on transmission lines. The experiment was performed for rod-to-rod gaps in the range of 0.4 to 3m. The influence of humidity on the 50% flashover voltage is small. The humidity coefficent for a short tail wave is about 1/3 of that for the standard wave. The 50% flashover voltage rises rapidly for waves with a tail times shorter than several micro s. In the short time region below 2 micro s, there is no difference in the V-t characteristics between short tail waves and the standard wave. The probability of concurrent flashover at parallel gaps is higher for short tail waves than for the standard wave. The unbalanced insulation is less effective for at the higher insulation level for short tail waves was about 1/5 of the value for the standard wave. (15 figs, 1 tab, 24 refs)

7734 **(CRIE-W—86039) Response and lightning protective effect of metal-oxide arrester for 110kV transmission line.** Ito, Hideo; Izumi, Kunikazu; Takanashi, Mitsugu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755729/JAW.

In respect of zinc oxide surge arresters for 110kV transmission line, its residual voltage characteristics for steep front current impulses and its protection coordination with suspension insulator assemblies for transmission line were investigated. As a sesult, the residual voltage of the arrestors increased with front steepness of discharge current, and the voltage at discharge current of 10kA with front-time of 1.0 micro sec. was 492 kV resulting in about 10% higher value than that for the standard front-time wave. The voltage buildup rate was nearly equal to the upper limit value assumed for power plants or substations. In terms of the flashover characteristics of ordinary insulator assemblies, a withstand voltage value was 573kV resulting in the tolerance of about 16%. As the arresters were attached to one circuit of 110kV double circuit transmission line, it was clarified that the arresters had a remarkable effect to prevent backflashover due to lightning. (18 figs, 4 tabs, 3 refs)

7735 **(CRIE-Y—87007) Environment design of power distribution facilities. Measurement of scenic effects.** Yamamoto, Kimio; Yamashita, Yo; Wakatani, Yoshifumi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 48p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755732/JAW.

In order to estimate quantitatively the effects of a environment design such as undergrounding of distribution poles or wires for power distribution facilities on the creation of pleasant pedestrian spaces, the development of a effect measurement method was attempted. Many examples of environmentally designed distribution facilities were collected, their design methods were classified systematically according to the visual evaluation points of distribution facilities, and the evaluation formula of the disorderlyness of streets with five physical parameters such as amounts of tree, signboard, trash and distribution pole were deduced. The method to measure improvement effects by the environment design was developed using above estimated values, and as the result of case studies for twelve typical streets, the practicality of the evaluation formula and measurement method were confirmed. Furthermore, more trees or less signboards or trashes as well as the environment design of distribution facilities were pointed out to be more effective in creating pleasant streets. (13 figs, 161 photos, 11 tabs)

7736 **(CRIE-Y—87010) Visual design of distribution facilities.** Yamashita, Yo; Yamamoto, Kimio. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 32p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Based on the existing studies for the environment design of distribution facilities, the detailed visual design of distribution facilities was proposed. After the present design survey of distribution facilities and street furnitures, the points of the facility design were summarized in following five items: basic design for integration, sophistication of details, consideration for human activities in street space, ceation of values added by complex features, and compatible design with other street furnitures. The detailed design method of detail, texture, color and space arrangement was proposed for overhead or road distribution facilities considering various items such as unit facility, group facilities or integration with street, and for streets lined with office buildings, busy quarters or woody residential streets, case studies were carried out. As a result, the existing environment design methods were effective to create various design ideas. (20 figs, 6 photos, 4 tabs)

7737 **(EPRI-EL—6081) Static electrification control in power transformers: Final report.** Oommen, T.V. (Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Sharon, PA (USA)). Dec 1988. 161p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004390/JAW.

The flow of insulating fluid through the insulation ducts in a power transformer inevitably produced electrostatic charge separation. The separated charges may accumulate on the solid insulation and in the bulk oil in the upper tank. Excessive charge accumulation in these regions may lead to partial discharges, tracking, and flashover. A detailed laboratory study was undertaken to identify the factors influencing charge separation. Transformer oils and a synthetic insulating fluid, perchloroethylene (WECOSOL), were evaluated for their charging tendencies. The dependence of charging tendency on temperature, moisture content and aging were also studied. A chemical analysis was attempted to identify and isolate trace charge producing species in high charging oils. A flow model incorporating a paper tube test section was designed and used to determine the effect of flow conditions on charge development. Both current and voltage development were studied as a function of flow velocity and temperature. The flow conditions were adjusted to obtain laminar and turbulent flows. The possibility of discharges from charge accumulation was demonstrated with the flow model. To control electrification effects a low charging insulating fluid may be used in transformers. Furthermore, the flow conditions and operating procedures must be optimized to minimize the effects of charge separation. 20 refs., 88 figs., 10 tabs.

7738 **(PB—89-104749/XAB) Low-frequency oscillations in electric-power systems. Report for August 1985-July 1986.** Hsu, Y.Y. (National Taiwan Univ., Taipei). 1986. 78p. NTIS, PC E05/MF E05.

Design of power-system stabilizers for improving the dynamic stability of Taiwan power systems are examined, using the frequency-domain approach. The eigenvalues and eigenvectors for Taiwan power system are computed using an efficient computer program called AESOPS (Analysis of Essentially Spontaneous Oscillations in Power Systems) in order to identify the optimum location for stabilizer applications and to determine a suitable set of parameters for the PSS. The results obtained from the proposed frequency domain approach have been verified by time-domain simulations and field tests.

# 21 NUCLEAR POWER PLANTS

*REFER ALSO TO CITATION(S) 7465, 7773, 7776, 8564, 8572, 10108*

7739 **(NUREG/CR—4639-Vol.3-Pt.1) Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR): Guide to data processing and revision: Part 1, Technical overview.** Gilmore, W.E.; Gertman, D.I.; Gilbert, B.G.; Reece, W.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-76ID01570. 46p. (EGG—2458-Vol.3-Pt.1). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89003839/JAW.

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is an automated data base management system for processing and storing human error probability (HEP) and hardware component failure data (HCFD). The NUCLARR system software resides on an IBM (or compatible) personal microcomputer. Users can perform data base searches to furnish HEP estimates and HCFD rates. In this manner, the NUCLARR system can be used to support a variety of risk assessment activities. This volume, Volume 3 of a 5-volume series, presents the procedures used to process HEP and HCFD for entry in NUCLARR and describes how to modify the existing NUCLARR taxonomy in order to add either equipment types or action verbs. Volume 3 also specifies the various roles of the administrative staff on assignment to the NUCLARR Clearinghouse who are tasked with maintaining the data base, dealing with user requests, and processing NUCLARR data. 5 refs., 2 figs.

## 2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

*REFER ALSO TO CITATION(S) 7789, 7796, 7812, 7813, 7816, 7818, 7820, 7821, 7825, 7837, 7842, 7845, 7847, 8711*

7740 **(CONF-8810155—22) Initial assessment of the processes and significance of thermal aging in cast stainless steels.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 39p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003633/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Charpy-impact and J-R curve data for thermally aged cast stainless steel are presented. The effects of material variables on the embrittlement of cast materials are evaluated. The chemical composition and ferrite morphology have a strong effect on the kinetics and extent of embrittlement. The procedure and correlations for predicting the impact strength and fracture toughness of cast component during reactor service are described. 19 refs., 17 figs., 4 tabs.

7741 **(LA-UR—88-3845) Once-through steam-generator sensitivity calculations.** Steiner, J.L.; Siebe, D.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 29p. (CONF-8810155—21). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003495/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

A series of TRAC-PF1/MOD2 thermal-hydraulic calculations has been performed to determine the effect of uncertainties in modeling once through steam-generator (OTSG) secondary-side phenomena on the calculated behavior of Babcock & Wilcox power plants. The calculations were performed by varying parameters in correlations for the secondary-side phenomena. The parameters and transients were chosen to show the maximum expected sensitivity of the calculated results to the parameter variations. The parameters were then varied over a range representing the estimated uncertainty in the correlation. In this manner, the sensitivity if the calculated plant behavior to the modeling uncertainties was determined with a reasonable number of calculations. The sensitivity of calculated plant behavior to variations in interfacial heat-transfer in the OTSG secondaries was determined in a series of steam-genera-

tor overfill transient calculations. Calculations were performed for a main steam line break (MSLB) transient to quantify the sensitivity to variations in interfacial drag in the secondaries; the interfacial drag was varied in these calculations to indicate the effects of entrainment and de-entrainment processes, for which no specific models exist in the code. In addition to the transient calculations, a series of steady-state calculations was performed to determine the sensitivity of the OTSG primary-to-secondary heat transfer to the assumed fraction of tubes wetted by the auxiliary feedwater (AFW) injection. The plant model used for the sensitivity calculations was qualified by performing a benchmark calculation for a natural circulation test in the TMI-1 plant.

7742 **(NUREG—0020-Vol.12-No.11) Licensed operating reactors: Status summary report, data as of October 31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Dec 1988. 491p. NTIS, PC A21 - GPO - OSTI. Order Number TI89004449/JAW.

The US Nuclear Regulatory Commission's monthly Licensed Operating Reactors Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Information Resources Management, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. Since all of the data concerning operation of the units is provided by the utility operators less than two weeks after the end of the month, necessary corrections to published information are shown on the Errata page. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

7743 **(NUREG/CR—5180) Chemical decontamination and chemical cleaning of LWR components and possible interactions with metallurgical aging effects.** Diercks, D.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 41p. (ANL—88-30). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89004103/JAW.

The basis for a recently initiated program on the chemical decontamination of nuclear reactor components and its possible impact on extended-life service are described. The economic incentives to the utilities of extending the life of nuclear power plants beyond the present 40-year limit are noted, and the aging degradation processes that may be accentuated in extended-life service are described. The CAN-DECON{trademark} and LOMI chemical decontamination processes for nuclear plant primary systems are summarized, and the results of prior studies on their corrosive effects on reactor structural alloys are reviewed in detail. Available experience with the Electric Power Research Institute Steam Generator Owner's Group chemical cleaning process for the secondary side of pressurized water reactor steam generators is also reviewed. 43 refs., 6 tabs.

7744 **(STUDSVIK/NI—88/3) Investigation of BWR stability in Forsmark 2. Based on multivariable noise analysis.** Oguma, R.; Reisch, F.; Bergdahl, B.G.; Lorenzen, J.; Aakerhielm, F.; Kellner, S. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 29 Jan 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756094/JAW.

A series of noise measurements have been conducted at the Forsmark-2 reactor during its start-up operation after the revision in 1987. The main purpose was to investigate the BWR stability problem based on noise analysis, i.e. the problem of resonant power oscillation with frequency of about 0.5 Hz, which tends to arise at high power and low core flow condition. The noise analysis was performed to estimate the noise source which gives rise to the power oscillation, to evaluate the stability condition of the Forsmark-2 reactor in terms of the decay ratio (DR), as well as to investigate a safety related problem in connection with the BWR stability. The results indicate that the power oscillation is due to dynamic coupling between the neutron kinetics and thermal-hydraulics via void reactivity feedback. The DR reached as high as ≅0.7 at 63% of the rated power and 4100 kg/s of the total core flow. An investigation was made for the noise recording which represents a strong pressure oscillation with a peak frequency at 0.33 Hz. The result suggests that such pressure oscillation, if the peak frequency coincided with that of the resonant power oscillation, might become a cause of scram. The present noise analysis indicates the importance of a BWR on-line surveillance system with functions like stability condition monitoring and control system diagnosis.

7745 **(STUDSVIK/NI—88/12) BWR-stability investigation at Forsmark 1.** Bergdahl, B.G.; Reisch, F.; Oguma, R.; Lorenzen, J.; Aakerhielm, F. (Studsvik Energiteknik AB, Nykoeping (Sweden)). 22 Mar 1988. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756095/JAW.

A series of noise measurements have been conducted at Forsmark 1 during start-up operation after the revision summer '87. The main purpose was to investigate BWR-stability problems, i.e. resonant power oscillations of 0.5 Hz around 65% power and 4100 kg/s core flow, which tend to arise at high power and low core flow conditions. The analysis was performed to estimate the noise source which gives rise to the oscillation, to evaluate the measure of stability, i.e. the Decay Ratio (Dr) as well as to investigate other safety related problems. The result indicates that the oscillation is due to the dynamic coupling between the neutron kinetics and thermal hydraulics via void reactivity feedback. The Dr ranged between values of 0.7 and $> 0.9$, instead of expected 0.6 ($Dr=1$ is defined as instability). These high values imply that the core cannot suppress oscillations fast enough and a small perturbation can cause scram. Further it was found that the entire core is oscillating in phase (LPRM's) with varying strength where any connection to the consequences of different fuel (8x8, 9x9) being present simultaneously cannot be excluded. This report elucidates the importance of an on-line BWR-stability surveillance system with functions like stability condition monitoring and control system diagnosis.

## 2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

*REFER ALSO TO CITATION(S) 7740, 7742, 7743, 7771, 7790, 7796, 7808, 7809, 7810, 7811, 7812, 7813, 7816, 7818, 7820, 7825, 7842, 7843, 7847, 8141*

7746 **(CEA-DAS—506) Stress corrosion cracking of inconel X-750 failure of assembly bolts of internal parts in a PWR power plant.** Olivera, J.J.; Pierrey, J.L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Aug 1988. 14p. (CONF-8806289—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755989/JAW.

From Congress on materials engineering for safety nuclear power generation; Nice, France (22 Jun 1988).

After 100 000 hours'work, several bolt heads of the core barrel joint were found separated from their cask inside the vessel of the first French pressurized water reactor (P.W.R). The expertise of these Inconel X-750 parts showed that the breakage resulted from stress corrosion cracking (S.C.C). All bolts were replaced by new ones, geometrically identical and made from the same material but with a new heat treatment in order to be more stress corrosion cracking-resisting (S.C.C-resisting). A comparative metallurgical study of obsolete and new bolts was carried out in order to make a correlation between S.C.C-resistance and the structure of materials. The results show some differences in carbide precipitation between the least and the most S.C.C-resisting material.

7747 **(CNEN-DR-DAS-NT—01/88) Systematization of Angra-1 operation attendance - Maintenance and periodic testings.** Furieri, E.B.; Carvalho Bruno, N. de; Salaverry, N.A. (Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ. Dept. de Reatores). 1988. 53p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704679/JAW.

A maintenance analysis, their types and their functions for the safety of nuclear power plants is done. Programs and present trends in the reactor maintenance, as well as the maintenance program and periodic tests of Angra I, are analysed. The necessities of safety analysis and a systematization for maintenance attendance are discussed and the periodic testing as well as the attendance of international experience. (M.C.K.).

7748 **(INIS-BR—1375) Pellet-cladding contact in a fuel rod and its simulation by finite elements.** Tanajura, C.A.S. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1988. 140p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705171/JAW.

A model to analyse the mechanical behavior of a fuel rod of a PWR is presented. We drew our attention to the phenomenon of pellet-pellet and pellet-cladding contact by taking advantage of a model which assumes the hypotheses of axisymmetry, elastic behavior with infinitesimal deformations and changes of the material properties with temperature. It also includes the effects of swelling and initial relocation. The problem of contact gives rise to a variational formulation which employs Lagrangian multipliers. With this approach an iterative scheme is constructed to obtain the solution. The finite element method is applied to space discretization. The model sensibility to some parameters and its performance concerning fuel rod behavior is discussed by means of numerical simulations.

7749 **(NIIAR—16(727)) Studying the WWER-1000 mock-up fuel elements irradiated in the MIR reactor.** Shamardin, V.K.; Pokrovskij, A.S.; Grachev, A.F. and others. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704889/JAW.

Results of investigating the WWER-1000 mock-up fuel elements tested in the MIR reactor up to 30-35 MWxday/kg uranium dioxide burnup under the maximum 350-480 W/cm linear power are presented. The reduction of central opening in fuel pellets with the initial helium pressure in the fuel elements being 0.1 MPa started at 350 W/cm linear power and in fuel elements with 2.0 MPa pressure-at 450 W/cm linear power. Comparison of serviceability of claddings of Zr+1% Nb, Zr+1% Nb+0.13% O/sub 2/ and Zr+1% Nb+1.3% Sn+0.4% Fe alloys has shown that claddings of Zr+1% Nb alloy in which under 0.1 MPa initial helium pressure in the fuel element the diameter reduction made up 0.15% possess the lowest creep resistance. Energy release splash, its magnitude being dependent on the rupture length is observed in the fuel rod rupture zones. It is ascertained that the presence of ruptures of up to 16 mm does not lead to fuel element serviceability decline. 6 refs.; 7 figs.; 3 tabs.

7750 **(NUREG/CR—5192) Testing of a naturally aged nuclear power plant inverter and battery charger.** Gunther, W.E. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Sep 1988. Contract AC02-76CH00016. 58p. (BNL-NUREG—52158). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89004052/JAW.

A naturally aged inverter and battery charger were obtained from the Shippingport facility. This equipment was manufactured in 1974, and was installed at Shippingport in 1975 as part of a major plant modification. Testing was performed on this equipment under the auspices of the NRC's Nuclear Plant Aging Research (NPAR) Program to evaluate the type and extent of degradation due to aging, and to determine the effectiveness of condition monitoring techniques which could be used to detect aging effects. Steady state testing was conducted over the equipment's entire operating range. Step load changes were also initiated in order to monitor the electrical response. During this testing, component temperatures were monitored and circuit waveforms analyzed. Results indicated that aging had not substantially affected equipment operation. On the other hand, when compared with original acceptance test data, the monitoring techniques employed were sensitive to changes in measurable component and equipment parameters indicating the viability of detecting degradation prior to catastrophic failure. 7 refs., 34 figs., 12 tabs.

## 2103 Power Reactors, Non-breeding, Graphite Moderated

*REFER ALSO TO CITATION(S) 7787, 7801, 7802, 7813, 7822, 7823, 7826, 7827, 7828, 7829, 7830, 7831, 7832, 7833, 7834, 7835, 7842*

7751 (INIS-SU—56, pp 3-6) **Calculational and experimental analysis on development of some algorithms for the VG-400 reactor power distribution control and monitoring system using the GROG critical assembly.** Karpov, V.A.; Paramonov, V.V.; Udyanskij, Yu.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The VG-400 reactor power distribution control and monitoring system uses neutron detector readings in the top axial and radial reflectors for reconstructing spatial energy distribution in the pebble bed core. The detector readings are processed by the methods realized in the MOD and SCURT codes. The spatial distribution of the /sup 235/U(n,f) reaction rates over the volume of the GROG critical assembly core, being a scale model of start charging of the VG-400 reactor, is experimentally studied. For two critical assembly states calculations are performed according to the MOD and SCURT codes, permitting to estimate the accuracy of energy release field reconstruction. The conclusion is made that neutron field distributions are more precisely reconstructed in the core centre than at the periphery. The calculation error is 3-9%. 5 refs.; 1 fig.; 3 tabs.

7752 (INIS-SU—56, pp 6-8) **Development of the programs for physical calculation of the VG-400 reactor using the results of the GROG bench experiments.** Karpov, V.A.; Paramonov, V.V.; Udyanskij, Yu.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The testing results of the NEKTAR, WIMS-D4 and VIANKA programs used in designing the VG-400 reactor for calculation of neutron-physical characteristics of the core are considered. The results of calculations performed for the VG-400 core and GROG critical assembly bench used for experimental study of the VG-400 reactor physics are given. The data obtained have demonstrated satisfactory coincidence of the measured and calculated results. They also permit to estimate the possibilities of VG-400 reactor scale modelling at the GROG bench. 7 refs.; 2 figs.

7753 (INIS-SU—56, pp 8-10) **Substantiation of the design and power selection of the HTGR modular plant for methane catalytic steam conversion.** Luzin, I.P.; Paramonov, E.D.; Fedorovich, E.D.; Shan'gin, B.V.; Pozdeev, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The design of a dual-purpose power plant with high-temperature helium cooled reactor for hydrogen production of a natural gas by the method of methane catalytic steam conversion and electric power generation is considered. During a year-long operation (7000 h) of the plant every 100 MW of thermal power enable to produce 40000 t of hydrogen and 220000 t of CO/sub 2/ when generating 22 MW of electric power at consumption of 80000 t of methane and 180000 t of water. It is shown that to determine the optimal reactor capacity and select the optimal design of a steam reformer (an aggregate for methane conversion by high-potential heat generated by the coolant) the nomogram method is applicable. 5 refs.; 2 figs.

7754 (INIS-SU—56, pp 10-13) **Development and use of the model of high temperature gas cooled reactor plant operation.** Bulygin, V.V.; Portnova, T.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The problems associated with the development of the model of operation of NPPs with HTGR are discussed. On the basis of analysis of statistical data on operation of plants with different reactor types, including those on the causes of AVR reactor scrams, the main operational conditions that should be taken into account in the model under consideration are determined. 14 refs.; 3 tabs.

7755 (INIS-SU—56, pp 13-15) **Developing the program and technique for vibrational tests of HTGR thermal shield structure elements.** Maksimov, N.G.; Kharlamov, A.G.; Mirenkov, A.F.; Andreev, V.A.; Koregin, Yu.A.; Kadilov, S.V.; Evstaf'ev, Yu.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The program and methodical aspects of selection of the necessary frequency range, vibration acceleration levels, time of operations, arrangement of vibroconverters, processing and representation of the results when testing the thermal shields for the HTGR reactors using the vibration machine are considered. On the basis of analysis of the frequency spectrum of the HTGR vibration sources and test results for the PG-100 helium loop element vibrations a frequency range from 20 to 2500 Hz is selected for testing. This frequency range is recommended to be divided into 7 octaves. The maximum in acceleration vibration load is up to 100 dB (30 mxs/sup -2/). The cycle number varies within the limits of (1.9-30)x10/sup 6/, test duration is 4-32 h. The considered program assumes online recording of frequency data for analyzing the resonance modes and vibration forms. 5 figs.

7756 (JAERI-M—88-165) **Analytical study on effective coolant flow rate of flange type fuel element for very high temperature gas-cooled reactor.** Fumizawa, Motoo; Suzuki, Kunihiko; Murakami, Tomoyuki; Hayakawa, Hitoshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1988. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756061/JAW.

The objective of present study is to evaluate and to increase the effective coolant flow rate of VHTR (very high temperature gas-cooled reactor) core whose thermal output is 50 MW and core outlet gas temperature is 950 DEG-C, without changing the sizes of the core and fuel element. Four types of fuel element are discussed, they are two flange type pin-in-block fuel elements which have 18 fuel rods (P18) and 36 fuel rods (P36), a flange type multihole fuel element (MH8) and a dowel type pin-in-block fuel element (P15). The flow distribution analysis was carried out by flow network code which calculated coolant pressure, flow rate and temperature. As the result, the followings were obtained: Effective coolant flow rate (W-bar/sub eff/) became lower in the order, MH8, P36, P18 and P15 fuels. W-bar/sub eff/ of the P15 fuel was the lowest, because crossflow loss coefficient of dowel type fuel element was lower than that of flange type. W-bar/sub eff/ of the P36 fuel was higher than that of the P18 fuel, because of larger total cross section of coolant flow channels. W-bar/sub eff/ of the MH8 fuel was higher than that of the P36 fuel, because of larger equivalent diameter of the channels. This analysis clearly revealed that the effective coolant flow rate increased by using the fuel element with large values of crossflow loss coefficient, cross section and equivalent diameter of coolant flow channels.

## 2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

7757 (AECL—8962) **Flow distribution in adjacent subchannels of unequal size.** Bugg, J.D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.; Ottawa Univ., Ontario (Canada)). Nov 1985. 178p. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88704980/JAW.

This report describes an experimental and analytic investigation of the single phase flow distribution in subchannel geometries. It was intended as an investigation of fundamental transport mechanisms and therefore concentrated on simple geometries with two interconnected subchannels. The experimental phase consisted of detailed measuremnts of the fluid velocity in a geometry representing two communicating subchannels of different sizes. These measurements were made at three axial locations along the test section. The size of one of the subchannels was varied to give subchannel area ratios of 1.0, 0.68, 0.50 and 0.32. Two Reynolds numbers (108000 and 180000) were investigated. Axial pressure gradient data for all of these cases was also taken. The analytic phase concentrated on applying a three dimensional finite difference fluid flow code to subchannel geomtries. The code was applied to the cases studied in the experiment as well as other investigator's results. It used the two equation K-$\epsilon$ turbulence model. The performance of this model was assessed. Unique features of the subchannel flows were identified and discussed. Conclusions regarding the transport mechanisms involved and the ability of a multidimensional code to predict the flow fields reliably were presented.

7758 (AECL—9101) **CANDU advanced fuel cycles. A long-term energy source.** Slater, J.B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1986. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704984/JAW.

This report is based on informal lectures and presentations made on CANDU Advanced Fuel Cycles over the past year or so, and discusses the future role of CANDU in the changing environment for the Canadian and international nuclear power industry. The changing perspectives of the past decade lead to the conclusion that a significant future market for a CANDU advanced thermal reactor will exist for many decades. Such a reactor could operate in a stand-alone strategy or integrate with a mixed CANDU-LWR or CANDU-FBR strategy. The consistent design focus of CANDU on enhanced efficiency of resource utilization combined with a simple technology to achieve economic targets, will provide sufficient flexibility to maintain CANDU as a viable power producer for both the medium- and long-term future.

7759 (INFO—0190) **Mode shape and natural frequency identification for seismic analysis from background vibration.** Bhan, S.; Wozniak, Z. (Acres International Limited, Niagara Falls, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Feb 1986. 79p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705114/JAW.

The feasibility of calculating natural frequencies and mode shapes of major equipment in a CANDU reactor from the measurements of their response to background excitation has been studied. A review of vibration data measured at various locations in CANDU plants shows that structures responded to a combination of random and harmonic background excitation. Amplitude of measured vibration is sufficient to allow meaningful data analysis. Frequency content in the 0 to 50-Hz range, which is of interest for earthquake response, is present in some of the vibration measurements studied. Spectral techniques have been developed for determining the response function of structures from measured vibration response to background excitation. The natural frequencies and mode shapes are then evaluated graphically from the frequency function plots. The methodology has been tested on a simple cantilever beam with known natural frequencies and mode shapes. The comparison between the theoretical and the computed natural frequencies and mode shapes is good for the lower modes. However, better curve-fitting techniques will be required in future, especially for higher modes. Readily available equipment necessary for the

measurement of background vibration in a CANDU plant (which is commercially available) has been identified. An experimental program has been proposed to verify the methodology developed in this study. Recommendations are also made to study methods to improve the accuracy of the mode shape and natural frequency prediction.

7760 **(OH—82452) Nuclear electrolytic hydrogen. A utility costing study.** Barnstaple, A.G.; Petrella, A.J. (Ontario Hydro, Toronto (Canada)). May 1982. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705213/JAW.

An extensive study of hydrogen supply has recently been carried out by Ontario Hydro which indicates that electrolytic hydrogen produced from nuclear electricity could offer the lowest cost option for any future large scale hydrogen supply in the Province of Ontario, Canada. This paper provides a synopsis of the Ontario Hydro study, a brief overview of the economic factors supporting the study conclusion and discussion of a number of issues concerning the supply of electrolytic hydrogen by electric power utilities.

7761 **(UTIAS-TN—239) Numerical prediction of blast-wave flows outside and inside a power house of a nuclear-power generating station.** Gottlieb, J.J.; Saito, T.; Zhang, K.Y. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Apr 1985. 154p. NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705223/JAW.

The blast-wave flows both outside and inside a power house of a nuclear-power generating station, from an accidental explosion of an explosive like TNT or its equivalent during transportation past the power house by a train, are studied numerically and assessed with an appropriate model. Detailed descriptions of both the prediction model and numerical method of solution are given, as well as an interpretation of numerical results. The blast-wave flow into the power house through blow-out panels in the front wall is investigated, including the resulting flow inside the power house that travels through the turbine hall, through the turbine auxiliary bay, over the reactivity deck, through the reactor building, and, in some cases, down through a hoistway to three small rooms on the next lower level. Breaking blow-out panels in the rear wall of the power house and their effects on the internal blast-wave flow is also investigated. Two different flow paths are considered, one through an upper level of the power house and another through a lower level. Finally, the blast-wave flow over the outside of the power house is studied, with an approximate model, so that the pressure differences from the blast wave between the inside and outside of the roof, side walls, front wall, and rear wall can be determined and the resultant blast-wave loading on the building walls thereby obtained.

## 2105 Power Reactors, Breeding

*REFER ALSO TO CITATION(S) 7813, 7848*

7762 **A movable boundary model for once-through steam generator analysis.** Tzanos, C.P. (Argonne National Lab., Reactor Analysis and Safety Div., 9700 South Cass Avenue, Argonne, IL (US)). *Nuclear Technology;* **82**: No. 1, 5-20(Jul 1988).

A method was developed for the analysis of a once-through steam generator that is based on a multinode movable boundary formulation and an accurate description of the departure from nucleate boiling boundary. In the development of this method, a liquid-metal reactor steam generator was used as a reference design. To evaluate its performance, the Energy Technology Engineering Center steam generator shutdown experiment in the once-through mode was analyzed. Also, the predictions of this method were compared with those of another steam generator code. These analyses showed that the predictions of this methodology agree very well with the experimental measurements and the predictions of the other code. The maximum difference between the temperatures predicted by this model and measurements was --5 K.

## 2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

*REFER ALSO TO CITATION(S) 7598*

7763 **Energy conversion system optimization study for multimegawatt space nuclear power applications.** Parlos, A.G.; El-Genk, M.S.; McGhee, J.M.; Buden, D.; Mims, J. (Dept. of Nuclear Engineering, Texas A and M Univ., College Station, TX (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 3, 1030-1040(Jun 1988).

The major objective of this paper is to present a detailed description of the energy conversion system analysis and optimization procedures that were part of a broader preliminary study aimed at designing a multimegawatt (MMW) space nuclear power system. In optimizing the energy conversion system it is assumed that the most massive component of the system is the radiator and therefore the subject of optimization is the radiator mass. The closed loop Brayton and the liquid metal Rankine cycles are analyzed for a 165 MWe system. The radiator mass optimized systems based on both cycles are compared for a wide range of operating conditions. In addition, for a 165 MWe power output, the MMW power system mass is calculated using an open loop Brayton cycle. For the desired electric output, results show that the hydrogen cooled/potassium Rankine cycle is the recommended energy conversion system since it is superior to any closed loop Brayton cycle. Additionally, results show that the open loop Brayton cycle system with hydrogen working fluid has mass comparable to the selected Rankine cycle system.

7764 **Multimegawatt power sources for commercial space operations.** Dearien, J.A.; Martinell, J.S. pp 11.2-11.7 of Space Congress, 25th, Cocoa Beach, FL, Apr. 26-29, 1988, Proceedings. Cape Canaveral, FL; Canaveral Council of Technical Societies (1988). (CONF-8804176—).

From 25. space congress; Cocoa Beach, FL, USA (26 Apr 1988).

The two types of power sources available for long-term use in space, solar and nuclear energy, are evaluated. The size relationship between solar and nuclear energy with respect to energy generation is analyzed. Consideration is given to energy utilization, electrical energy, thermal energy, and power process requirements.

## 2107 Regulation And Licensing

*REFER ALSO TO CITATION(S) 7771*

7765 **(INIS-XN—129) Agreement between Denmark and Sweden on exchange of information and notification concerning nuclear power plants.** (International Atomic Energy Agency, Vienna (Austria)). 21 Oct 1986. 3p. (In Danish). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704920/JAW.

In the context of the adoption of the IAEA Convention on Early Notification of a Nuclear Accident, Denmark and Sweden have entered into an agreement supplementing the provisions of the Convention with regard to direct notification and advance communication of technical information. The agreement applies to facilities and activities as specified in Article 1 of the IAEA Convention and provides that information comprising design, safety systems, radiation protection and measures to limit release of radioactive materials in the event of an accident shall be continually exchanged. The Parties undertake to directly inform one another forthwith in the case of an abnormal safety-related event which gives rise to emergency measures inside or outside the facility. The Party providing information shall respond promptly to a request from the other State for further information or for consultation following such an event.

7766 **(INIS-XN—130) Agreement between Denmark and Finland on exchange of information and notification concerning nuclear power plants.** (International Atomic Energy Agency, Vienna (Austria)). 25 Feb 1987. 4p. (In Danish). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704921/JAW.

In the context of the adoption of the IAEA Convention on Early Notification of a Nuclear Accident, Denmark and Finland have entered into an agreement supplementing the provisions of the Convention with regard to direct notification and advance communication of technical information. The agreement applies to facilities and activities as specified in Article 1 of the IAEA Convention and provides that information comprising design, safety systems, radiation protection and measures to limit release of radioactive materials in the event of an accident shall be continually exchanged. The Parties undertake to directly inform one another forthwith in the case of an abnormal safety-related event which gives rise to emergency measures inside or outside the facility. The Party providing information shall respond promptly to a request from the other State for further information or for consultation following such an event.

7767 **(INIS-XN—132) Scale of severity for incidents and accidents in nuclear reactors.** (Ministere de l'Industrie, des P et T et du Tourisme, 75 - Paris (France); International Atomic Energy Agency, Vienna (Austria)). 19 Apr 1988. 15p. (In French). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704923/JAW.

This scale, whose principle is similar to that used to measure the severity of earthquakes, is intended to facilitate mutual understanding between nuclear technicians, the media and public opinion, by a simplified classification of incidents and accidents likely to occur in nuclear power plants.

7768 **(SAAS-Mitt—88-04) Guideline on radiation protection requirements for ionizing radiation shielding in nuclear power plants.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705221/JAW.

The guideline which entered into force on 1 May 1988 stipulates the radiation protection requirements for shielding against ionizing radiation to be met in the design, construction, commissioning, operation, and decommissioning of nuclear power plants.

7769 **(SAAS-Mitt—88-06) Guideline on qualification requirements and on further training of research reactor personnel to ensure atomic safety and radiation protection.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705222/JAW.

The guideline which entered into force on 3 June 1988 governs the qualification and further training requirements to be met by persons who are responsible for ensuring atomic safety and radiation protection during commissioning, operation, maintenance, and decommissioning of research and training reactors as well as subcritical assemblies.

7770 **Turbine missiles assessment.** Vo, T.V. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). *Nuclear Technology;* **82**: No. 1, 21-35(Jul 1988).

In a study commissioned by the U.S. Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory evaluated the costs and benefits of modifying regulatory requirements in the area of the turbine rotor design reviews and inspections. The basis for the analysis was presented in the Regulatory Analysis Guidelines and in the Handbook for Value-Impact Assessment. The effects of selected modifications to regulations were evaluated in terms of public risk and costs to industry and the NRC. The results indicate that substantial savings in operating costs may be realized by changing the interval of turbine rotor inspections.

## 2108 Economics

*REFER ALSO TO CITATION(S) 7844, 7920*

7771 **(DOE/IG—0261) Richland Operations Office procedures for funding the WNP-1 project study and the allowability of associated costs incurred.** (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). 22 Nov 1988. 12p. H. Order Number TI89004213/JAW.

Report to The Secretary.

We evaluated the procedures and practices used by the Richland Operations Office (RL) to fund a study concerning the feasibility of acquiring and converting a partially completed commercial power-generating reactor to tritium production. We also analyzed the allowability of costs charged by contractors and subcontractors who performed the study. This audit was conducted in conjunction with an Office of Inspector General Inspection Report issued December 2, 1987. We followed generally accepted Government auditing standards and included tests of internal controls and compliance with laws and regulations to satisfy the scope of audit. We studied and evaluated applicable internal controls, limited to a review of the system, to understand the control environment. Therefore, our review would not necessarily disclose all internal control deficiencies which may have existed; however, our review did show matters presented here which may constitute material weaknesses and should be considered when preparing the yearend assurance memorandum on internal control deficiencies. Except as discussed here, tested items were in compliance with applicable laws and regulations. Further, nothing came to our attention to indicate that untested items were not in compliance with such laws and regulations.

7772 **(INIS-XN—144) Electricity, nuclear power and fuel cycle in OECD countries.** (Nuclear Energy Agency, 75 - Paris (France)). 1988. 35p. (In English, French). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704934/JAW.

A questionnaire on Electricity Generation, Nuclear Power and Fuel Cycle Data is distributed annually to OECD Member Countries. In the questionnaire of January 1988, countries were asked to provide data for 1986 and 1987 and most likely projections up to the year 2005. The replies to the questionnaire (or estimates for unavailable data) are presented in this Booklet. Data for 1987 are provisional for several countries. The data on electricity generation and electric capacity are presented to the year 2005, and the data on fuel cycle services to the year 2000. The Addendum contains an analysis of the present and past projections for installed nuclear capacity to 2000. It shows the total capacity of those plants connected to the grid, under construction and firmly planned to be in operation in 2000 as 282 GWe. The new projection of 300 GWe is above this estimate, indicating that some countries are considering further expansion of their nuclear capacities within this timeframe.

# 22 NUCLEAR REACTOR TECHNOLOGY

7773 **(EDF-DER-RA—1987-1) D.E.R. 87 Panorama.** Anon. (Electricite de France, 75 - Paris). 1987. 266p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88756035/JAW.

This progress report presents the panorama of the studies carried out by the "Direction des Etudes et des Recherches" (DER) of EDF : classical and nuclear thermal power plants, hycraulic power plants, electrical equipment, network analysis, environmental impacts, uses of electric power, normalization, informatics. A selection of the publications for 1987 is presented.

## 2201 Theory And Calculation

*REFER ALSO TO CITATION(S) 10532*

7774 **(CEA-tr—2291) Method and program for complex calculation of heterogeneous reactor.** Kalashnikov, A.G.; Glebov, A.P.; Elovskaya, L.F.; Kuznetsova, L.I. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1988. 23p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756000/JAW.

An algorithm and the GITA program for complex one-dimensional calculation of a heterogeneous reactor which permits to conduct calculations for the reactor and its cell simultaneously using the same algorithm are described. Multigroup macrocross sections for reactor zones in the thermal energy range are determined according to the technique for calculating a cell with complicate structure and then the continuous multi group calculation of the reactor in the thermal energy range and in the range of neutron thermalization is made. The kinetic equation is solved using the Pi- and DSn- approximations.

7775 **Stability analysis of synthetic acceleration methods with anisotropic scattering.** Valougeorgis, D.; Williams, M.; Larsen, E.W. (Virginia Polytechnic Institute and State Univ. Center for Transport Theory and Mathematical Physics Dept. of Mathematics, Blacksburg, VA (US)). *Nuclear Science and Engineering;* **99**: No. 2, 91-98(Jun 1988).

A study of the spectral radius for the continuous form of the source iteration, diffusion synthetic acceleration, and various P/sub L/ acceleration methods ($L \geqq 1$) for anisotropically scattering neutron transport is carried out via a Fourier stability analysis. The purpose of the study is to determine which acceleration scheme is optimum. The problem is formulated as a matrix eigenvalue problem with, in general, $N + 1$ iteration eigenvalues $\omega$ where N denotes the degree of anisotropy. The P/sub 1/ acceleration method is determined as the most efficient P/sub L/ approach for the cases of linearly and quadratically anisotropic scattering.

## 2202 Components And Accessories

*REFER ALSO TO CITATION(S) 7774, 7794, 7849, 8118, 8120, 8572*

7776 **(ENEA-RT-DISP—87-3) Steels and welding nuclear. A data of nuclear carbon steels and weldings irradiated in material testing reactors.** Sessa, M.; Milella, P.P. (ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria). (ENEA, Rome (Italy)). 1987. 500p. (In Italian). NTIS (US Sales Only), PC A21/MF A01 - OSTI. Order Number DE88704900/JAW.

This ENEA Data-Base regards mechanical properties, chemical composition and heat treatments of nuclear pressure vessel materials: type A533-B, A302-B, A508 steel plates and forgings, submerged arc welds and HAZ before and after nuclear irradiation. Irradiation experiments were generally performed in high flux material test reactors. Data were collected from international available literature about water nuclear reactors pressure vessel materials embrittlement.

7777 **(INIS-mf—11844) Technology for disposal of cuttings from the underwater plasma fusion cutting of austenitic nuclear components. Final report.** Arndt, K.D.; Bach, F.W.; Boedeker, B.; Krieger, F. (Salzgitter A.G. (Germany, F.R.); Hannover Univ. (Germany, F.R.). Inst. fuer Werkstoffkunde; Noell G.m.b.H., Wuerzburg (Germany, F.R.)). (Salzgitter A.G. (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Salzgitter A.G. (Germany, F.R.); Hannover Univ. (Germany, F.R.). Inst. fuer Werkstoffkunde; Noell G.m.b.H., Wuerzburg (Germany, F.R.)). Aug 1985. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755954/JAW.

The cutting waste products from underwater plasma cutting that arise both in the water and in the air were collected and passed through selected air and water storing filters. Then the concentration and particle size distribution of the dust contained in the raw gas and particles suspended in the raw water were measured. Parallel measurements were made in the same way with the pure gas and water. The obtained results permitted the degree of separation and the storing capacity of the chosen filter systems to be determined. The tests have shown that for air filtration, submicron particulate air filters (box and drum type) are appropriate. With water filtration however, the degrees of separation and storing capacity typical of air filters could not be achieved. Here the 0.2 $\mu$m and 0.45 $\mu$m membrane filters were found to be the most suitable of the filters used. Proposal for a disposal concept: Dismantling inside the pressure vessel or the fuel element storage pool. Disposal of cuttings via air filtering system with suction bell, single-stage filter and fan and water filtering system with suction, device at the cutting torch, suction lines and circulation pump. (orig./HP) With 14 refs., 11 tabs., 81 figs.

7778 (INIS-SU—57/A, pp 3-15) **Behaviour of a cement stone with chemical additions under short high temperature effects.** Falikman, V.R.; Veselova, V.I.; Ershov, V.Yu.; Muzalevskij, L.P. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.
In Designing and building. Scientific-technical collection.

The purpose of the paper is to investigate the influence of different chemical additions used in NPP construction on thermal stability of a cement stone under short- and high-temperature effects. S-3 and dihydroxyphenyl utilized as peptizing agents for increase of placeability of concrete mixtures as well as sodium nitrite utilized as an antifreezing addition at concreting at low temperatures are used as additions. The investigations were conducted in the 0-900 deg C temperature range divided into 4 ranges. Shrinkage and mass losses of specimens were determined. The obtained data show that specimens with additions are subjected to smaller shrinkage and mass losses as compared with specimens without additions. The highest positive effect is attained in portland cements with active mineral additions. 4 refs.; 5 figs.; 4 tabs.

7779 (INIS-SU—57/A, pp 16-20) **Autoclave-hardening slag-alkali binder with high water content.** Korenevskij, V.V.; Kozyrin, N.A.; Melikhova, N.I.; Narkevich, N.K.; Ryabov, G.G. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.
In Designing and building. Scientific-technical collection.

The results of investigations into properties of slag-alkali binder, that may be used for concretes of reactor radiation and thermal shieldings, are presented. These concretes have increased chemical stability and mechanical strength, high content of chemically bound water (approximately 14%), that is not lost under heating up to 550 deg C. Dumping and granulated slags of blast-furnace process, sodium-bicarbonate-alkali fusion cake formed at burning of adipic acid residues, technical sodium hydroxide and sodium liquid glass are used as raw material for slag-alkali binder. 4 refs.; 1 fig.

7780 (INIS-SU—57/A, pp 21-28) **Temperature conditions of the off-vessel dry shield tank.** Kiselev, N.A.; Panchenko, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.
In Designing and building. Scientific-technical collection.

The results of computerized calculations of temperature conditions of off-vessel dry shield tank of radiation-resistant concrete with improved thermal conductivity cooled by water transmitted through Field tubes are presented. Effects of specific power release, the coefficient of shielding concrete thermal conductivity and its possible lamination from the steel shell and Field tubes on the temperature regime of the tank are disclosed. 3 refs.; 4 figs.; 4 tabs.

7781 (INIS-SU—57/A, pp 43-58) **Relation between function and structure in NPP main building design.** Gorb, Yu.M. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.
In Designing and building. Scientific-technical collection.

The importance of architecture and construction problems when designing NPPs is considered. Relation between certain technological systems and arrangement of parts of the building in them is disclosed. The main functional-structural complexes forming the volume of the building are discovered. The planning and design characteristic of the construction solution conditioned by technological factors is given. Examples of practical application of the conducted investigations in certain designs are presented. The investigation resulted in development of the model of causality-consequence relations between the function and structure of NPP buildings. Rather high level of reliability of this model is confirmed by practice of its application when designing Shevchenko NPP, some NPPs with RBMK-1000 reactors and Ignalina NPP. 4 refs.; 8 figs.

7782 **(JAERI-M—88-183) Transient characteristics of heat pipes.** Tsuyuzaki, Noriyoshi; Saito, Takashi; Ishigami, Shinya; Kawada, Michitaka; Konno, Masanobu; Kaminaga, Fumito; Okamoto, Yoshizo. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 132p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756065/JAW.

When the heat pipe is used in a nuclear engineering field, it is indispensable to understand transient characteristics as well as in a steady state at a normal operation. However there have been few informations about the transient characteristics of a heat pipe in case of rapid temperature or heat load change in an evaporator section. The purpose of this study is to examine transient characteristics of a gravity assisted heat pipe and variable conductance heat pipe (VCHP) which will be used in a neutron irradiation capsule. The response time of the heat pipe was a few seconds under the operation temperature of evaporator part.

7783 **(NIIAR—13(724)) Automated system for thermal and physical researches.** Petukhov, V.P.; Ajnikeev, R.R.; Potamanova, N.P. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704888/JAW.

An automated system of thermal and physical studies designed for carrying out experiments at the nuclear power plant with BOR-60 fast neutron reactor, at the atomic power and heating plant ACT-1 and on a bench with a sodium coolant for model tests of sodium-water steam generators is described. The system comprises three independently functioning subsystems. Each subsystem has the regime of acquisition and preliminary processing experimantal data as well as the regime of data transmission. The system includes three RPT terminals with peripheral devices and Plurimat-S computer. 3 refs.; 1 fig.

7784 **(NUREG/CR—4639-Vol.3-Pt.3) Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR): Guide to data processing and revision: Part 3, Hardware component failure data entry and revision procedures.** Gilmore, W.E.; Gertman, D.I.; Gilbert, B.G.; Reece, W.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-76ID01570. 91p. (EGG—2458-Vol.3-Pt.3). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89003841/JAW.

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is an automated data base management system for processing and storing human error probability (HEP) and hardware component failure data (HCFD). The NUCLARR system software resides on an IBM (or compatible) personal microcomputer. Users can perform data base searches to furnish HEP estimates and HCFD rates. In this manner, the NUCLARR system can be used to support a variety of risk assessment activities. This volume, Volume 3 of a 5-volume series, presents the procedures used to process HEP and HCFD for entry in NUCLARR and describes how to modify the existing NUCLARR taxonomy in order to add equipment types of action verbs. Volume 3 also specifies the various roles of the administrative staff on assignment to the NUCLARR Clearinghouse who are tasked with maintaining the data base, dealing with user requests, and processing NUCLARR data.

7785 **Acoustic resonance in heat exchanger tube bundles - Part I: Physical nature of the phenomenon.** Blevins, R.D.; Bressler, M.M. (GA Technologies Inc., San Diego, CA (US)). pp 19-26 of Flow-induced vibrations-1987. Au-Yang, M.K.; Chen, S.S. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

The intense acoustic resonance resulting from gas flow across a bank of heat exchanger tubes in a duct has been investigated experimentally and theoretically. At low gas velocities, the acoustic tone emanating from tube bundles increases in proportion to the flow velocity. When the frequency approaches a bound acoustic transverse mode of the tube bundle, intense sound can result. Sound levels as high as 173 db were measured within the bundle. During resonance, the sound correlates vortex shedding from the tubes and the pressure drop increases in some bundles.

## 2203 Fuel Elements

*REFER ALSO TO CITATION(S) 7749*

7786 **(INFO—0227) Molten fuel-moderator interaction. An investigation of the potential for steam explosion.** Lee, J.H.S.; Kynstautas, R. (McGill Univ., Montreal, Quebec (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Feb'1987. 84p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705132/JAW.

A critical review of the current understanding of vapor explosions was carried out. It was concluded that, on the basis of actual industrial accidents and large scale experiments, energetic high yield steam explosion cannot be regarded as an improbable event if large quantities of molten fuel and coolant are mixed together. This study also reviewed a hydrodynamic transient model proposed by Henry and Fauske Associates to assess a molten fuel-moderator interaction event. It was found that the proposed model negates a priori the possibility of a violent event, by introducing two assumptions: 1) fine fragmentation of the molten fuel, and ii) rapid heat transfer from the fine fragments to form steam. Using the Hicks and Menzies thermodynamic model, maximum work potential and pressure rise in the calandria were estimated. However, it is recommended that a more representative upper bound model based on an underwater explosion of a pressurized volume of steam be developed.

7787 (INIS-SU—56, pp 26-28) **Developing the technique for out-of-pile measurements of thermal-physical properties of irradiated spherical fuel elements.** Zhulidov, A.B.; Kharlamov, A.G.; Krasnov, V.I.; Pavlov, G.M. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The design of hot cells for determining effective temperature and thermal conductivity of irradiated spherical fuel elements is considered. In the bulk of a gas-vacuum cell with water-cooled walls an ohmic heater of about 750 W power, which ensures fuel element heating up to 1000 deg C in helium medium at 1.3x10/sup 5/ Pa, is mounted. A pair of identical chromel-alumel thermocouples is used as a transducer. The temperature in the fuel element centre and its periphery is recorded by a measuring set providing automated temperature measurements with an absolute error of 0.025-0.25 K. The measurement results are processed on the BESM-6 computer. The results measured using the given hot cells are in good agreement with the data obtained at the laboratory set-up. 3 refs.; 5 figs.

7788 **(KFK—4438) Experimental investigation on the structure of turbulence in symmetrical wall subchannels and comparison with the results in an asymmetrical channel.** Wu, S.R.; Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1988. 153p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755971/JAW.

Measurements of the mean velocity, the wall shear stresses, and the turbulent Reynolds stresses were performed in two symmetrical wall subchannels of a rod bundle. The rod bundle of our parallel rods was arranged symmetrically in a rectangular channel with a pitch-to-diameter ratio of P/D = 1.148 and a wall-to-diameter ratio of W/D = 1.045. The Reynolds number of this investigation was Re = 6.11x10/sup 4/. The experimental results show that the structure of turbulence in this rod bundles differs greatly from the structure in circular tubes. Especially in the narrow gaps between the rods and the channel walls there are increased levels of turbulent intensities in the axial and azimuthal directions and, hence of the kinetic energy of turbulence. In contrast to a previous investigation of this geometry, however arranged asymmetrically in the rectangular channel, the momentum transport between the subchannels across the gap between the rods is negligible. The comparison between experimental wall stress distributions and those computed by the VELASCO code shows strong deviations, especially in the gaps between the rods and channel walls.

7789 **(SKI—84108) SVEA spray cooling test. Summary report.** Eklund, R.; Wijkstroem, H.; Baeckwall, M.O. (Swedish Nuclear Power Inspectorate, Stockholm; ASEA-ATOM AB, Vaesteraas (Sweden)). Mar 1987. 31p. (ASEA-ATOM-RP—87-39; ASEA-ATOM-SVEA—87-28). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755683/JAW.

The test programme has been based on a realistic experimental simulation of a large recirculation line break in an external recirculation pump BWR. Variations have been made from this base in order to test more conservative choices of the test parameters. About 50 tests were successfully performed within the project. The experiments have provided data which verify the improved heat transfer characteristics of the SVEA fuel bundle design compared to the standard 8x8 fuel. Tests have been performed at power levels corresponding to average planar heat generation rates up to 45 kW/m with both slightly conservative (ANS-79 + 2$\sigma$) and a very conservative (ANS-71 + 20%)power decay curve. With realistic values of other paramaters the peak rod temperature was measured to 994 degrees C and 1093 degrees C for these two decay powers. The influence of total spray flow rate and of spray flow distribution has been investigated in a series of tests. These tests show that with uniform sub-bundle spray flow rates the peak rod temperature is only moderately influenced by a reduction of the total spray flow rate to 45% of the minimum available spray flow rate in a Swedish external pump reactor. Maldistribution tests show no influence of minimum sub-bundle spray flow rate down to 25 g/s and only moderate influence in the extreme case of zero sub-bundle spray flow rate. Variations in other parameters including pressure, initial rod temperatures and steam venting direction have also been made within this project. The resulting changes in peak clad temperature were small, indicating only slight influence of these parameters. The programme has also included radiation tests mainly to provide data for evaluation of surface emissivities. (authors).

## 2204 Control Systems

*REFER ALSO TO CITATION(S) 7744, 7745, 7770, 7813*

7790 **(BMU—1988-178) Impact of faulty response of overload protection systems on the reliability of electricity supply.** Schweigert, J.; Schnuerer, G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1988. 127p. (In German). (GRS-A—1375). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Protection equipment of the engineered safety system which is to prevent the triggering of actions via signals from the reactor protection system is to be made so reliable that it has no impact on the non-availability of the supplied systems. Design and functional mode of the various overload protection equipment and the relevant switching device and combinations are explained together with the requirements such as choice, design, and adjustment of the protection equipment, followed by a survey of possible causes of faulty response of overload protection device and of the means and measures available for improvement. The now presented version of September 1987 of the 'overload protection report deals basically with all main topics of the Juli 1985 version, but has been updated and extended by material taking into account practice-oriented data on the new developments in convoy power plant design.

7791 **(DOE/ID—10191) Artificial intelligence applications in the nuclear industry.** Majumdar, D. (ed.). (USDOE Idaho Operations Office, Idaho Falls). Oct 1988. Contract AC07-76ID01570. 160p. NTIS, PC A08/MF A01. Order Number DE89003775/JAW.

This is a state-of-the-art review of artificial intelligence (AI) applications in the nuclear industry. It was initiated as a result of the American Nuclear Society-sponsored conference on "Artificial Intelligence and Other Innovative Computer Applications in the Nuclear Industry," held in Snowbird, Utah, August 1987. This conference brought together a large number of international experts and showed extensive worldwide applications of expert systems in the nuclear industry. This document is a postconference review and a reflection on the current status and the future of AI in the nuclear industry. Because artificial intelligence techniques can analyze large and complex arrays of information, develop smaller sets of higher-level conclusions, incorporate human expertise, and present information suitable for human intelligence, it is very appropriate for applications in complex nuclear power plant operation. Some advances have already been made in several areas. However, among the many applications in the nuclear industry, there does not appear to be any outstanding application to date such as the ones found in the medical or geological fields. What comes out clearly is that the nuclear industry is experimenting in many areas with the expert system technology and determining its usefulness for the industry. On the international scene, the United States is the current leader in knowledge and applications, followed by Japan and France. However, the Japanese appear to have embraced the AI concept more wholeheartedly. This review encompasses a large number of areas including fault diagnosis, reactor control, plant operation, alarm filtering, accident management, robotics, probabilistic risk assessment, and the human element of expert systems. The potential for useful application of AI technology in the nuclear industry is shown to be promising. 383 refs., 13 figs., 11 tabs.

7792 **(DOE/NE/37959—24) Development and testing of an Integrated Signal Validation System for nuclear power plants: Annual report for the period September 30, 1987--September 29, 1988.** Upadhyaya, B.R.; Kerlin, T.W.; Holbert, K.E.; Gloeckler, O.; Morgenstern, V.; Eryurek, E.; Olvera, J.; Qualls, A.L. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Sep 1988. Contract AC02-86NE37959. 232p. NTIS, PC A11/MF A01 - OSTI. Order Number DE89003519/JAW.

The objective of the university-industry joint research program at the University of Tennessee and its subcontractor, Combustion Engineering, Inc., is to develop and implement a comprehensive signal validation system for current power plants and future advanced reactors. In large power generating systems and process control systems, outputs from several hundred instrumentation channels are used in control systems, protection systems and plant monitoring systems. The routine validation of these signals is very useful in increasing the reliability of operation decisions, in improving the plant control actions and in minimizing plant downtime. The comprehensive signal validation system developed under this project consists of several parallel signal processing modules, and their integrated information is used to detect, isolate and characterize faulty signals. The application of the various signal validation techniques may be extended to such problems as predictive maintenance advising and instrumentation calibration reduction, and for the development of intelligent instrumentation systems.

7793 **(ENEA-RT-TIB—88-3) Dynamics model for real time diagnostics of Triga RC-1 system.** Gadomski, A.M.; Nanni, V.; Meo, G. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 41p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704905/JAW.

This paper presents dynamics model of TRIGA RC-1 reactor system. The model is dedicated to the real-time early fault detection during a reactor operation in one week exploitation cycle. The algorithms are specially suited for real-time, long time and also accelerated simulations with assumed diagnostic oriented accuracy. The approximations, modular structure, numerical methods and validation are discussed. The elaborated model will be build in the TRIGA Supervisor System and TRIGA Diagnostic Simulator.

7794 **(EUR—11147) Licensing issues associated with the use of computers in the nuclear industry.** Ehrenberger, W.D.; Bloomfield, R.E. (Gesellschaft fuer Reacktorsicherheit m.b.H. (GRS), Garching (DE); Adelar, London (GB)). (Commission of the European Communities, Luxembourg). 1987. 264p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88756004/JAW.

Computers are increasingly important to ensuring the safety of nuclear power stations. They have been proposed or introduced into operator information systems, operational control systems, as well as into systems for core protection and plant protection. Although the developments in the individual countries are not at the same pace, they do tend to render similar results. Particular licensing problems arise because of the increasing complexity of computer systems and the software involved. In the past licensing has been closely connected with the mental understanding of the systems to be licensed. This understanding is endangered with greater complexity of the systems. Although several "manual" methods of licensing exist, the problem of cost effective licensing is still more or less unsolved. For the future it is expected that tools will reduce the licensing efforts leaving the licenser and assessor free to concentrate on the most important issues. Such tools will probably make use of artificial intelligence techniques. They will enable the inclusion of more complex functions into safety systems and thereby increase the number of safety criteria and the number of echelons od defense. Another important use of artificial intelligence techniques will be the area of operator information systems and maintenance, including computer hardware maintenance. They will provide early detection of problems in the plant and thereby largely enhance plant availability and safety. Further studies are being proposed in the fields of software licensing tools, artificial intelligence, fail-safe and fault-tolerant software architectures, test procedures and system specification.

7795 **(PSI—15) Detection of boiling by Piety's on-line PSD-pattern recognition algorithm applied to neutron noise signals in the SAPHIR reactor.** Spiekerman, G. (Paul Scherrer Institut, Wuerenlingen (Switzerland)). (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Sep 1988. 137p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704894/JAW.

A partial blockage of the cooling channels of a fuel element in a swimming pool reactor could lead to vapour generation and to burn-out. To detect such anomalies, a pattern recognition algorithm based on power spectra density (PSD) proposed by Piety was further developed and implemented on a PDP 11/23 for on-line applications. This algorithm identifies anomalies by measuring the PSD on the process signal and comparing them with a standard baseline previously formed. Up to 8 decision discriminants help to recognize spectral changes due to anomalies. In our application, to detect boiling as quickly as possible with sufficient sensitivity, Piety's algorithm was modified using overlapped Fast-Fourier-Transform-Processing and the averaging of the PSDs over a large sample of preceding instantaneous PSDs. This processing allows high sensitivity in detecting weak disturbances without reducing response time. The algorithm was tested with simulation-of-boiling experiments where nitrogen in a cooling channel of a mock-up of a fuel element was injected. Void fractions higher than 30 % in the channel can be detected. In the case of boiling, it is believed that this limit is lower because collapsing bubbles could give rise to stronger fluctuations. The algorithm was also tested with a boiling experiment where the reactor coolant flow was actually reduced. The results showed that the discriminant D5 of Piety's algorithm based on neutron noise obtained from the existing neutron chambers of the reactor control system could sensitively recognize boiling. The detection time amounts to 7-30 s depending on the strength of the disturbances. Other events, which arise during a normal reactor run like scrams, removal of isotope elements without scramming or control rod movements and which could lead to false alarms, can be distinguished from boiling. 49 refs., 104 figs., 5 tabs.

7796 **(RL—237(86)) Aerosol in the containment. A comparative analysis of pre-test computations for LACE 01.** Lanza, S.; Mariotti, P. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari). (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari). 1986. 54p. (In Italian). NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE88704937/JAW.

The US program LACE (LWR Aerosol Containment Experiments), in which Italy participates together with several European countries, Canada and Japan, aims at evaluating by means of a large scale experimental activity at HEDL the retention in the pipings and primary container of the radioactive aerosol released following severe accidents in light water reactors. At the same time these experiences will make available data through which the codes used to analyse the behaviour of the aerosol in the containment and to verify whether by means of the codes of thermohydraulic computation it is possible to evaluate with sufficient accuracy variable influencing the aerosol behaviour, can be validated. This report shows and compares the results obtained by the participants in the LACE program with the aerosol containment codes NAVA 5 and CONTAIN for the pre-test computations of the test LA 1, in which an accident called containment by pass is simulated.

## 2205 Environmental Aspects

*REFER ALSO TO CITATION(S) 7810, 7814, 7828, 7829, 7830, 7831, 7833, 7835, 7837, 9270, 9319, 9320, 9329, 9392, 9503, 10123*

7797 (JINR-D—9-87-105-Vol.2, pp 363-367) **Estimation of the UNK radiation effects on the environment.** Azhgirej, I.L.; Bajshev, I.S.; Lebedev, V.N.; Maslov, M.A.; Mokhov, N.V.; Uzunyan, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Estimations of the UNK radiation effects on the accelerator equipment and environment are made. The number of protection measures at the UNK is described. Liquid helium activation in the UNK cryogenic system and its possible rated and emergency leaks according to the estimations do not require any additional protective measures. The calculations show that in case of design level of beam losses the concentration of restricted radionuclides on the Earth surface at the expense of atmospheric wastes of activated air from underground tunnels will be in doses hundreds of times lower than the permissible dose, and the dose rate - tens of times lower the permissible ones. 7 refs.; 5 figs.

7798 (JINR-D—9-87-105-Vol.2, pp 403-405) **Protection of ground waters from irradiation by accelerators in deep tunnels.** Antipyuk, A.I.; Bulgakov, M.V.; Getmanov, V.B.; Mitin, M.F. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Different variants of assembled-dismountable and solid protection of ground waters from activation as applied to metro-type tunnels, constructed by the groove method, are considered. To choose the most economic structural solution of protection for different degrees of neutron fluence decrease in relation to the costs for tunnelling the tunnel cross section with inner diameter of 5.1 m and thickness of ferroconcrete tubing working of 200 mm is taken as a model one. It is shown that the use of concrete with volumetric mass of 2350 kg/m/sup 3/ in all the variants considered is not economical. The most economical is concrete with the volumetric mass of 3650 kg/m/sup 3/. Substitution of a heavier concrete for the tubing working concrete for the tunnel 5.1 m in diameter does not lead to a noticeable effect. The highest degree of fluence de-

crease of 1.5 x 10/sup 6/ can be attained when concrete protection with volumetric mass of 6300 kg/m/sup 3/ in the tunnel 10 m in diameter is used. 5 refs.; 2 figs.

## 2206 Research, Test, And Experimental Reactors

*REFER ALSO TO CITATION(S) 7742, 7793, 7812, 8145, 8378*

**7799 (DOE/ER/75205—1) Upgrade of the RPI [Rensselaer Polytechnic Institute] Reactor Critical Facility: Final report.** Harris, D.R. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Apr 1988. Contract FG02-85ER75205. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003793/JAW.

The Reactor Critical Facility (RCF) at Rensselaer Polytechnic Institute (RPI) has been converted from highly enriched uranium (HEU) fuel plates to low-enriched (4.81 wt %) uranium (LEU) SPERT fuel rods. The LEU fuel rods are similar to light water power reactor fuel, and critical experiments on them are of interest for new high burnup fuel applications. Use of the SPERT fuel also enhances the educational function of the RCF. Thus this work has constituted a major upgrade of the RCF. 13 refs., 1 tab.

**7800 (INIS-mf—11330) Operation and Utilizations of Dalat Nuclear Research Reactor.** Hien, P.Z. (National Inst. for Nuclear Research, Da Lat (Viet Nam)). 1988. 6p. (CONF-8809213—).

From IAEA Meeting: 10th European TRIGA users' conference; Vienna, Austria (14 Sep 1988).

The reconstructed Dalat nuclear research reactor was commissioned in March 1984 and up to September 1988 more than 6200 hours of operation at nominal power have been recorded. The major utilizations of the reactor include radioisotope production, activation analysis, nuclear data research and training. A brief review of the utilization of the reactor is presented. Some aspects of reactor safety are also discussed. (author) 2 figs.; 5 refs.; 1 tab.

**7801 (JAERI-M—88-154) Design and evaluation of core flow distribution in High Temperature Engineering Test Reactor(HTTR).** Maruyama, Soh; Fujimoto, Nozomu; Sudo, Yukio; Kiso, Yoshihiro; Murakami, Tomoyuki; Takikawa, Noboru; Hayakawa, Hitoshi. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1988. 153p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756059/JAW.

The Japan Atomic Energy Research Institute is planning the Construction of High Temperature Engineering Test Reactor(HTTR) which is 30 MW in thermal power, 950 deg C of reactor outlet coolant temperature and 40 kg/cm/sup 2/g of coolant pressure. This report summarizes the results of design and evaluation of core flow distribution which is the basis of core thermal hydraulics in the HTTR along with the data base for the analysis of core flow distribution. The core consists of integrated graphite blocks and has many flow paths between blocks which are not available to effective cooling for fuel, fuel blocks and control rod guide blocks in the core. Therefore, the proper core flow distribution was determined for achievement of 950 deg C reactor outlet coolant temperature by the reduction of the coolant flow which is not effective to the direct cooling of fuel, fuel blocks and control rod guide blocks.

**7802 (JAERI-M—88-173) Verification of combined thermal-hydraulic and heat conduction analysis code FLOWNET/TRUMP.** Maruyama, Soh; Fujimoto, Nozomu; Sudo, Yukio; Kiso, Yoshihiro; Murakami, Tomoyuki. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1988. 80p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756063/JAW.

This report presents the verification results of the combined thermal-hydraulic and heat conduction analysis code, FLOWNET/TRUMP which has been utilized for the core thermal hydraulic design, especially for the analysis of flow distribution among fuel block coolant channels, the determination of thermal boundary conditions for fuel block stress analysis and the estimation of fuel temperature in the case of fuel block coolant channel blockage accident in the design of the High Temperature Engineering Test Reactor(HTTR), which the Japan Atomic Energy Research Institute has been planning to construct in order to establish basic technologies for future advanced very high temperature gas-cooled reactors and to be served as an irradiation test reactor for promotion of innovative high temperature new frontier technologies. The verification of the code was done through the comparison between the analytical results and experimental results of the Helium Engineering Demonstration Loop Multi-channel Test Section(HENDEL T/sub 1-M/) with simulated fuel rods and fuel blocks.

**7803 (JINR—13-88-58) Measurement and analysis of power pulse energy fluctuations in the IBR-2 reactor.** Pepelyshev, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704832/JAW.

The results of the experimental study of the power impulse energy fluctuations obtained during the IBR-2 energy start-up are presented. The influence of accidental oscillations of the core cooling system basic parameters and the vibrations of the moving reflectors on the reactor noise characteristics are analysed. For data processing the methods of the statistical analysis of stationary time series were used. It is shown that in the 25 s/sup -1/ operating mode the uncontrollable fluctuations of power are basically related to the Na flow through the reactor core ({similar←to}83%). But in the 5 s/sup -1/ operating mode these fluctuations are due to the axial oscillations of the moving reflectors ({similar←to}58%). During the whole period of the energy start-up the random effects of reactivity did not exceed (4+-4)x10/sup -5/ ΔK/K. And the mean power fluctuations at the reactor basic mode of operation 5 s/sup -1/ at W=2M were considerably less than tolerated ($\sigma$/sub Q//Q=4.3%, ΔQ/Q=30%). 7 refs.; 10 figs.; 3 tabs.

**7804 (JINR—13-88-59) Time characteristics of reactor noise parameters and vibrations of the IBR-2 reactor moving reflectors.** Pepelyshev, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704833/JAW.

The energy noise of power pulses and the vibrations of the moving reflectors (MR) during the IBR-2 reactor operation from 1983-1986 at a power of 1-2 MW were experimentally studied. An analysis is made of the influence of various random processes due to MR on the time dependence of the principal parameters of reactor noises. The data were processed with statistical methods. It was shown that long period trends of reactor noises (within 4 years) depend essentially on a change of MR vibrations. The change of the parameters of noises during some cycles of measurement (going for less than 18 days) depend also on instability of the sodium component of the reactor noise. There is reported that the reactor noise charateristics during the whole period of operation of the reactor with the reactivity modulators of first generation (additional moving reflector shaped as a trident and main moving reflector - blade) meet the design requirements. This is mainly due to a high stability of operation of the principal systems of the reactor: the cooling system and the reactivity modulation one. 3 refs.; 7 figs.; 1 tab.

**7805 (KURRI-TR—304) Summary reports of activities under visiting research program in Research Reactor Institute, Kyoto University, second half of 1987.** (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jul 1988. 97p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756076/JAW.

This report is published as occasion demands by summarizing the results of the functional test of various experimental facilities, the results of the test of articles made for trial, the state of radiation control and waste treatment, the data required at the time of research and experiment such as the reports at study meetings, the remarkable results and new methods obtained amid research, the discussion on other papers and reports and so on in the form of

prompt report. In this report, the title, the names of reporters and the summary of research of each of 80 visiting research projects at the KUR and 9 visiting research projects at the KUCA are reported. (J.P.N.).

7806 **(NIIAR—11(722)) Neutron-physical characteristics of the RBT-10/2 reactor experimental channels.** Bulycheva, L.V.; Vaneev, Yu.E.; Komarov, A.V. and others. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704887/JAW.

Using a combined calculational-experimental method the main neutron-physical characteristics of the experimental channels of the RBT-10/2 research reactor have been obtained. When filled with air the channel characteristics are within the following ranges: effective thermal neutron flux density is (2.4-4.8x10/sup 13/cm/sup -2/xss/sup -1/: fast neutron flux density (E>0.1 MeV) is (3.8-6.9)x10/sup 13/ cm /sup -2/xs/sup -1/. Gamma radiation dose rate in an iron sample is (1.1-2.0) kGyxs/sup -1/. 9 refs.; 3 figs.

7807 **(RISO-M—2745) Calculation of plate temperatures in a Mk LEU fuel element.** Haack, K. (Risoe National Lab., Roskilde (Denmark)). Sep 1988. 38p. NTIS (US Sales Only), PC A03/MF A01 - Risoe Library, DK-4000 Roskilde. Order Number DE88755678/JAW.

A calculation method for estimating the axial temperature distributions of each tube in each of the 26 fuel elements of the DR 3 core is described and demonstrated. With input data for fuel element power, D2O outlet temperature and main D2O circulator combination, a computer code calculates all important temperatures in the fuel element. 11 tabs., 32 ills. 8 refs.

## 2207 Plutonium And Isotope Production Reactors

*REFER ALSO TO CITATION(S) 7771, 7817*

## 2208 Propulsion Reactors

*REFER ALSO TO CITATION(S) 7770*

7808 **(AD-A—197387/4/XAB) Modular shipbuilding and its relevance to construction of nuclear power plants. Master's thesis.** Seubert, T.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). May 1988. 224p. NTIS, PC A10/MF A01.

The modern techniques of modular shipbuilding based on the Product Work Breakdown Structure as developed at the Ishikawajima-Harima Heavy Industries Co., Ltd. of Japan are examined and compared to conventional shipbuilding methods. The application of the Product Work Breakdown Structure in the building of the U.S. Navy's DDG-51 class ship at Bath Iron Works is described and compared to Japanese shipbuilding practices. Implementation of the Product Work Breakdown Structure at Avondale Shipyards, Incorporated is discussed and compared to Bath Iron Works shipbuilding practices. A proposed generic implementation of the Product Work Breakdown Structure to the modular construction of nuclear power plants is described. Specific conclusions for the application of Product Work Breakdown Structure to the construction of a light water reactor nuclear power plant are discussed.

7809 **(DOE/MA—9003452) The discipline of technology: Admiral Rickover and the naval nuclear propulsion program, 1957--1982.** Duncan, F. (USDOE Assistant Secretary for Management and Administration, Washington, DC. History Div.). 1982. 469p. NTIS, PC A20/MF A01 - OSTI. Order Number DE89003452/JAW.

Choosing a chronological point of departure is a question which plagues all historians. After much thought and discussion with colleagues, I chose the end of 1957. Research and development were vigorous and flourishing, but the basic technical principles were not in doubt: they were being pursued to reach new goals and extend the range of application. A completely chronological approach was impossible, but in the three areas of application I could sketch some of the history. The result is a series of essays. Chapter 1 sets forth some background on pressurized water reactor technology, Naval Reactors, Admiral Rickover and the Government framework in which the naval nuclear propulsion program functioned. Chapters 2 and 3 deal with the application of the technology to submarines, and chapters 4, 5, and 6 to naval surface ships. Chapter 7 is about a proposal to use nuclear propulsion as a diplomatic pawn. Chapter 8 is about the application of pressurized water reactor technology at the Shippingport Atomic Power Station, the world's first full-scale civilian nuclear power plant, and about the light water breeder effort. In Chapters 9, 10, and 11 the focus changes sharply, and is upon "The Discipline of Technology," a phrase Admiral Rickover frequently used to describe his own approach to technological innovation and operation. Chapter 9 describes the organization of the program in the later years of his leadership; Chapter 10 how Naval Reactors maintained standards of excellence; and Chapter 11 summarizes Admiral Rickover's philosophy of technology. 607 refs.

## 2209 Reactor Safety

*REFER ALSO TO CITATION(S) 7887, 7939, 9491*

7810 **(CEA-DAS—480) Presentation of the escadre system, together, with a practical application.** Dufresne, J.; Cenerino, G.; Dumas, J.M.; Gauvain, J.; Fermandjian, J.; L'heriteau, J.P.; Lhiaubet, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Aug 1988. 22p. (CONF-880309—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755987/JAW.

From International symposium on severe accidents in nuclear power plants AIEA - OECD/NEA; Sorrento, Italy (21 Mar 1988).

The Institute for Nuclear Safety and Protection (IPSN) is in charge of research in phenomenology of severe accidents which are not taken into account in the design basis but which could occur on the different types of reactor operated in France. Related potential applications are varied and include: - assessment of radioactive release as to nature, quantity and kinetics, in order to validate the population evacuation plans, - analysis of the efficiency of the procedures and corrective actions envisaged by the operating utilities to minimize the consequences of severe accidents, - general risk surveys for the PRA programs. In order to carry out this task effectively, the IPSN has developed a set of computer programs to model on the one hand, the physics of fission product transfers (release from damaged fuel, vapour and aerosol behavior, transport outside the reactor containment), and on the other hand, the core, primary system and containment thermal hydraulics (including the incidence of safeguard systems, ultimate emergency procedures and corium-concrete interaction) determining fission product transfer kinetics. The system is completed by provision for modelling fission product atmophere, aquatic and hydrological transfers outside the containment. This computer program, known as ESCADRE, is presented in this paper.

7811 **(CEA-DAS—511) Examination of the potential problems resulting from the settling of U5 procedure (filtered venting of the containment) on French PWR'S.** L'homme, A.; Serviere, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept d'Analyse de Surete; Electricite de France, 75 - Paris. Direction de l'Equipement). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1988. 6p. (CONF-8805177—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755990/JAW.

From CSNI specialists meeting on filtered vented containment systems; Paris, France (17 May 1988).

A filtered venting system of the containment including a sand bed (U5 procedure) is now settled on french PWR's. In this paper, one reviews the problems which are raised, concerning either the efficiency of the system or the safety of the nuclear unit. Two types of situations are examined: design situations, for which

the U5 procedure is not used, and hypothetical accidental situations, for which the U5 procedure could be used.

7812 **(CONF-881014—15) Summary results of the treat source term experiments project (STEP).** Baker, L. Jr.; Ritzman, R.L.; Fink, J.K.; Simms, R.; Schlenger, B.J.; Herceg, J.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003660/JAW.

From International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon, France (2 Oct 1988).

A series of four experiments has been conducted at the Argonne National Laboratory in the Transient Reactor Test Facility (TREAT) aimed at providing data for characterizing the radiological source term for severe light water reactor accidents having the greatest contribution to risk (1,2). In each of the tests, four fuel elements were exposed to environmental conditions similar to the fuel in a reactor at the time volatile fission products and noble gases are released. The 1 m long fuel elements had been irradiated in the Belgonucleaire BR-3 reactor to a burnup of about 35,000 MWd/T and then cooled for several years. The test fuel elements simulated the central portion of much longer PWR or BWR elements. Steam at 644 K flowed into the bottom of the fuel region in each test at rates predicted for the accidents being simulated. TREAT power was controlled at levels calculated to generate a simulated decay heating level and offset heat losses from the fuel bundle for about 20 min. 8 refs., 5 figs.

7813 **(CONF-8810155—17) ORNL R and D on advanced small and medium power reactors: Selected topics.** White, J.D.; Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003407/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

From 1984-1985, ORNL studied several innovative small and medium power nuclear concepts with respect to viability. Criteria for assessment of market attractiveness were developed and are described here. Using these criteria and descriptions of selected advanced reactor concepts, and assessment of their projected market viability in the time period 2000-2010 was made. All of these selected concepts could be considered as having the potential for meeting the criteria but, in most cases, considerable R&D would be required to reduce uncertainties. This work and later studies of safety and licensing of advanced, passively safe reactor concepts by ORNL are described. The results of these studies are taken into account in most of the current (FY 1989) work at ORNL on advanced reactors. A brief outline of this current work is given. One of the current R&D efforts at ORNL which addresses the operability and safety of advanced reactors is the Advanced Controls Program. Selected topics from this Program are described. 13 refs., 1 fig.

7814 **(CONF-8810232—1-Vugraphs) Trends status: Post-accident fission product chemistry.** Kress, T.S.; Beahm, E.C.; Shockley, W.C.; Weber, C.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03 - OSTI. Order Number DE89002328/JAW.

From Severe accident research partners meeting; Washington, DC, USA (17 Oct 1988).

It is important to understand and model the chemical and physical behavior of vapor iodine species in containment environments for the following reasons: This behavior can contribute significantly to severe accident source terms; the development of accident mitigation or management strategies (e.g., an effective filter system); for long-term clean-up and recovery following an accident; regulatory requirements (e.g., spray or pool additives); and design basis accidents (i.e., steam generator tube rupture). This document discusses the Oak Ridge National Laboratory "Post-Accident" Chemistry Program.

7815 **(DOE/ER/13489—3) An analysis of the closure conditions for two-fluid models of two-phase flow: Third year progress report.** Lahey, R.T. Jr.; Drew, D.A. (Rensselaer Polytechnic Inst., Troy, NY (USA)). 1988. Contract FG02-86ER13489. 73p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89003096/JAW.

The third year of research was focused on the assessment of two-fluid models of two-phase flow. The purpose of this report is to highlight the salient findings made during the report period. Typical two-phase flow models were assessed against the Second Law of Thermodynamics. In addition, a novel new ensemble cell averaging technique was developed and applied to the derivation of interfacial forces and Reynolds stresses in two-phase flows. Finally, predictions from a typical 3-D two-fluid model were compared with phase separation data. 4 refs.

7816 **(DOE/NE/37970—T8) A collection of publications and articles for a light water ultra-safe plant concept.** Klevans, E.H. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). 15 Oct 1988. Contract AC02-86NE37970. 49p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003529/JAW.

This collection contains reports titled: "The Penn State Ultra-Safe Reactor Concept; " "Ultra Safe Nuclear Power; " "Use of the Modular Modeling System, in the Design of the Penn State Advanced Light Water Reactor; " "Use of the Modular Modeling System in Severe Transient Analysis of Penn State Advanced Light Water Reactor; " "PSU Engineers' Reactor Design May Stop a Future TMI; " and "The Penn State Advanced Light Water reactor Concept."

7817 **(DPST—86-851) Modifications to the Emergency Core Cooling System to increase flow to the reactor.** Baker, W.H. (Savannah River Lab., Aiken, SC (USA)). 5 Jan 1987. Contract AC09-76SR00001. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003836/JAW.

The purpose of this report is not to recommend a specific number of additional Injection Paths but to show that they will eliminate the current power penalty and significantly improve ECCS reliability in response to a design basis LOCA. However, it is recommended that if and when additional Injection Path are installed the valves in half of the paths be submersible electric valves rather than hydraulically operated valves. This will eliminate failure of the hydraulic system as a dependent failure mode for all the valves. 8 refs., 3 tabs.

7818 **(EUR—10971) Occupational radiation dose statistics from light-water power reactors operating in Wester Europe.** Brookes, I.R.; Eng, T. (Central Electricity Generating Board, Gloucester (UK). Oldbury Nuclear Power Station; Swedish State Power Board, Vaellingby (SE)). (Commission of the European Communities, Luxembourg). 1987. 228p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756036/JAW.

Since the early days of nuclear power, collective and individual doses for people engaged in the maintenance and operation of nuclear power plants have been published by regulatory authorities. In 1979 a small working party whose members were drawn from Member States operating light-water reactors (LWRs) in the European Community was convened. The Working party decided that only by collection of data under a unified scheme would it ever be possible to properly compare plant performance and for this reason a questionnaire was drawn up which attempted to elicit the maximum of information with the minimum inconvenience to the plant staff. Another decision made by the working party was to broaden the data base from 'European Community LWRs' to 'West European LWRr' to try to take advantage of the considerable experience being built up in Sweden, in Finland and in Switzerland. All the data available to the Commission up to the end of 1984 are presented and commented on. The deductions are not exhaustive but are believed to represent the limits of what could sensibly be done with the data available. Results are presented separately for BWR and PWR but no other subdivision, say by country or maker, is made. Where interpretation can be enhanced by graphical presentation, this is done. In general, doses for each job category are expressed in various ways to reveal and afford comparisons.

7819 **(EUR—11361) DYLAM approach to systems safety and reliability assessment.** Amendola, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1988. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756008/JAW.

A survey of the principal features and applications of DYLAM (Dynamic Logical Analytical Methodology) is presented, whose basic principles can be summarized as follows: after a particular modelling of the component states, computerized heuristical procedures generate stochastic configurations of the system, whereas the resulting physical processes are simultaneously simulated to give account of the possible interactions between physics and states and, on the other hand, to search for system dangerous configurations and related probabilities. The association of probabilistic techniques for describing the states with physical equations for describing the process results in a very powerful tool for safety and reliability assessment of systems potentially subjected to dangerous incidental transients. A comprehensive picture of DYLAM capability for manifold applications can be obtained by the review of the study cases analyzed (LMFBR core accident, systems reliability assessment, accident simulation, man-machine interaction analysis, chemical reactors safety, etc.).

7820 **(EUR—11376) Diffusiophoresis of fission product aerosol in an LWR containment after core meltdown.** Snepvangers, L.J.M.; Van De Vate, J.F. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). (Commission of the European Communities, Luxembourg). 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756011/JAW.

Diffusiophoresis is shown to be one of the important fission product aerosol removal processes from the warm, humid atmosphere of the LWR containment under post-meltdown conditions. A critical literature review of the theoretical and the experimental research on diffusiophoresis is given. It is concluded that for large aerosol particles diffusiophoresis most likely is diffusion-slip modified Stefan flow conditioned. Experimental data on diffusiophoresis are of a limited nature both qualitatively and quantitatively. A number of experiments under relevant conditions of diffusiophoresis and thermophoresis for large particles are presented. Good agreement with diffusion-slip modified Stefan flow conditioned diffusiophoresis is obtained. The theories by Stetter (pure Stefan flow i.e. mean molar velocity) and Whitmore and Meisen (mean mass velocity) are shown to yield upper and lower limits respectively for the particle deposition velocities by diffusiophoresis.

7821 **(EUR—11435) Complete decontamination of the Lingen primary steam duct.** Ahlfaenger, W. (Kernkraftwerk Lingen G.m.b.H., Darme/Lingen (DE)). (Commission of the European Communities, Luxembourg). 1988. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756014/JAW.

In a previous work performed within the framework of the research programme of the European Community concerning the decommissioning of nuclear power plants, a procedure for the complete decontamination of austenitic materials has been developed in laboratory tests. In the present study, the application on a technical scale is described. A pipe piece of the primary steam duct of the Lingen Nuclear Power Station with a nominal diameter of 50 mm and a length of about 20 m was chosen as test object. As shown by the examination results, the pipe piece could be decontamined below the tolerance limits of the German Radiation Protection Regulation.

7822 **(FS—87-42-T) Conlusions to be drawn from the Chernobyl accident. Protective concepts and goals and their achievement. Information of the general public. Summary of a workshop, May 20-21, 1987, Stuttgart.** (Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.)). 1987. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755937/JAW.

The first leading topic of the workshop was: concepts providing for protection of the population, their practical implementation in case of accidents. The papers on this subject discuss the process of determining protective goals, the concepts developed in West Germany and in Switzerland, the concept presented by the German Federal government, the practical implementation of dose abatement measures in the Federal Lands, the Swiss concept for dose abatement as applied after the Chernobyl accident. The second topic was: information of the public, cooperation with the media, actions to be taken after an accident. This session discussed appropriate means of information in theory and practice, the chaotic situation created by the press after the Chernobyl accident, main aspects of radio and TV communications, requirements of information policy as seen by the Lagezentrum of the German Federal Government. (HSCH).

7823 **(IFE/KR/E—88/001) Economic consequences of the Chernobyl accident in Norway in 1986 and 1987.** Brynhildsen, L.; Tveten U. (Ministry of Agriculture, Oslo (Norway); Institutt for Energiteknikk, Kjeller (Norway)). (Institute for Energy Technology, Kjeller (Norway)). Oct 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755661/JAW.

The report summarizes the economic consequences of the Chernobyl accident to the Norwegian agriculture in the years 1986 and 1987.

7824 **(INIS-BR—1337) Preliminary report about Goiania radiological accident, Brazil.** Oliveira, A.R. de. (NUCLEOS, Rio de Janeiro, RJ (Brazil). Area de Saude). May 1988. 54p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704796/JAW.

The events that originate the Goiania radiological accident involving the rupture of Cesium 137 source, the source characteristics, the medical aspects related to the triage of victims, the medical attendance, and the special measurements of decontamination in the Goiania General Hospital (HGG), are described. (M.C.K.).

7825 **(JAERI-M—88-157) Dryout heat flux and flooding phenomena in debris beds consisting of homogeneous diameter particles.** Maruyama, Yu; Abe, Yutaka; Yamano, Norihiro; Soda, Kunihisa. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1988. 62p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756060/JAW.

Since the TMI-2 accident, which occurred in 1979, necessity of understanding phenomena associated with a severe accident have been recognized and researches have been conducted in many countries. During a severe accident of a light water reactor, a debris bed consisting of the degraded core materials would be formed. Because the debris bed continues to release decay heat, the debris bed would remelt when the coolable geometry is not maintained. Thus the degraded core coolability experiments to investigate the influence of the debris particle diameter and coolant flow conditions on the coolability of the debris bed and the flooding experiments to investigate the dependence of flooding phenomena on the configuration of the debris bed have been conducted in JAERI. From the degraded core coolability experiments, the following conclusions were derived; the coolability of debris beds would be improved by coolant supply into the beds, Lipinski's 1-dimensional model shows good agreement with the measured dryout heat flux for the beds under stagnant and forced flow conditions from the bottom of the beds, and the analytical model used for the case that coolant is fed by natural circulation through the downcomer reproduces the experimental results. And the following conclusions were given from the flooding experiments ; no dependence between bed height and the flooding constant exists for the beds lower than the critical bed height, flooding phenomena of the stratified beds would be dominated by the layer consisting of smaller particles, and the predicted dryout heat flux by the analytical model based on the flooding theory gives underestimation under stagnant condition.

7826 (KURRI-TR—298, pp 8-12) **Medical response at Chernobyl nuclear accident.** Kumatori, Toshiyuki. (Radiation Effects Association, Tokyo (Japan)). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The medical response to the nuclear accident at the Chernobyl nuclear power station was summarized. The assessment of the radiation dose received by individuals was made by biological dosimetry. Medical care involved treatment of skin lesions, supportive treatment to hematopoietic disturbance and gastrointestinal tract injury, and other organs damage. Infection prophylaxis was considered important. Bone marrow transplantation was done for those exposed to a high dose of radiation. Medical preparedness to radiation accident is urgently requested.

7827 (KURRI-TR—298, pp 13-21) **Contamination and radiation doses in European countries due to the Chernobyl accident.** Akaishi, Jun. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

Contaminations and radiation doses in western European countries are briefly reviewed. Higher contamination were observed in Austria, Scandinavian countries, Switzerland, Italy, F.R. Germany and Greece. The highest averaged individual effective dose equivalent evaluated was 0.65 mSv (in Austria), and averaged individual thyroid dose was 2.7 mSv (in Greece). The estimated total collective effective dose equivalent in western European countries is 7 x 10/sup 4/ man Sv, and this value is nearly equal to 1/10 of annual natural level.

7828 (KURRI-TR—298, pp 22-27) **Grobal scale diffusion of radioactive materials released in the accident at Chernobyl Nuclear Power Plant USSR.** Yoshikawa, Tomoaki. (Meteorological Research Inst., Tsukuba, Ibaraki (Japan)). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

Grobal scale diffusion of radioactive materials released in the accident at Chernobyl Nuclear Power Plant USSR were simulated, using the JMA routine meteorological prediction model and a diffusion model of random walk type. The computation represented the distribution of radioactive materials successfully which reached to Japan in a week through Siberia after the separation in V shape from the northward flow over Scandinavia.

7829 (KURRI-TR—298, pp 28-36) **System for prediction of environmental emergency dose information. Simulation calculation of long-term radioactive dispersion in Chernobyl reactor accident.** Moriuchi, Shigeru; Chino, Masamichi; Ishikawa, Hirohiko; Yamazawa, Hiromi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The simulation calculation analysis of environmental radioactivities at Chernobyl-4 reactor accident was carried out using SPEEDI (System for Prediction of Environmental Emergency Dose Information). The system consists of three-dimensional models of wind field calculation (WIND04), dispersion calculation (PRWDA) and internal and external dose calculation (CIDE), and is designed to speedily predict radioactive concentration in the air and on the ground and the resultant doses of upto 200 km range by simulation calculations when the radioactive materials are accidentally released from a reactor. At Chernobyl accident the calculational domain of SPEEDI were extended tentatively upto 2000 km, and simulation calculations of the movement of radioactive clouds were executed, and the amounts of released radioactivities were estimated using calculated results and observed data. The calculated distribution and the movement of plume well agreed with the distribution patterns presumed from observation data, and the estimated source term showed reasonable agreement with data reported from USSR and other countries.

7830 (KURRI-TR—298, pp 37-46) **Environmental monitoring around Tokai-Works after the reactor accident at Chernobyl.** Ishida, Junichiro; Narita, Osamu. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

Many radionuclides originating from the reactor accident at Chernobyl were detected around the TokaiWorks, PNC, since 3 - 4 May 1986. But /sup 239,240/Pu, /sup 241/Am and /sup 3/H were not significantly distinguished because their amounts were very small. On the other hand, /sup 110m/Ag was detected only in marine products such as cephalopoda and shellfish. Based on the monitoring data at one dairy farm, we derived an equation to model the transport of /sup 131/I from pasture grass to milk; the actual data of /sup 131/I in milk fits this equation.

7831 (KURRI-TR—298, pp 47-52) **Physicochemical species and particle size of airborne /sup 131/I due to Chernobyl accident in JAERI.** Ohhata, Tsutomu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The physicochemical species and particle size of airborne / sup 131/I due to Chernobyl accident have been measured in JAERI of 6 to 30 May 1986. The fractions of /sup 131/I species during the period were 19 % for particlate iodine, 5 % for I/sub 2/ , 6 % for HOI, and 70 % for organic iodides. These fractions were similar to airborne stable iodine observed at inland regions in USA. A mean particle size of particulate iodine was 0.85 μm in AMAD.

7832 (KURRI-TR—298, pp 1-7) **Emergency response in U.S.S.R. at the time of the accident of Chernobyl nuclear power plant.** Miyanaga, Ichiro. (Nuclear Safety Research Association, Tokyo (Japan)). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The report outlines the emergency measures taken by the Soviet authorities following the accident at the Chernobyl nuclear power plant that occurred on April 26, 1986. About 10 percent, or 250 tons, of the graphite moderator dissipated in the accident and fire took place in 30 places due to hightemperature materials released by the explosion. Water was used at first for cooling, but was soon found ineffective. Then such materials as silver (2,400 t), soil/clay (1,800 t), boron carbide (40 t) and dolomite (800 t) were dropped from helicopters onto the reactor core. This served rather effectively to cool the core. Two divers carried out the removal of water from the upper and lower pools. A tunnel was excavated from a trench near the No. 3 unit to the lower pool, which was then consolidated with concrete, while various sensors were installed in the upper pool. Nitrogen was supplied to eliminate oxygen from the bottom of the core. Afterwards, the degree of contamination and radiation level were analyzed and the position and stability of the core debris were determined. Various measures, including fixation of radioactivity, decontamination, and river protection, were taken to prevent the expansion of contamination. (Nogami, K.).

7833 (KURRI-TR—298, pp 59-63) **Assessment of the long-term environmental impact of the Chernobyl accident.** Kasai, Atsushi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

A draft for a report on the accident at the Chernobyl nuclear power plant was proposed at the 36th regular meeting of the United Nations Scientific Committee on the Effects of Atomic Ra-

diation (UNSCEAR) held on March 23 - 27, 1987. The present article briefly summarizes the contents of the draft. The draft, titled Assessment of the Long-Term Impact of the Chernobyl Accident, is designed to present data submitted by various countries and to show detailed assessment of the long-term environmental impact of the accident. Data presented include the amount of radioactive substances released in the accident (cited from the Soviet report submitted to IAEA), atmospheric diffusion of released radioactive substances, contamination of foods, and dose. Methods used in the draft for the assessment of environmental impact are briefly outlined and major conclusions made in the above-mentioned UNSCEAR meeting are listed. Some major study results, including the variation with time of the tissue dose rate per unit deposition density and variation with time of the cesium-137 concentration in milk, beef, grain and leafy vegetables per unit deposition density are also included. (Nogami, K.).

7834 (KURRI-TR—298, pp 64-68) **Protective measures adopted in OECD member countries in response to the Chernobyl accident.** Yoshida, Yoshikazu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The report outlines the measures for exposure prevention taken in West European countries following the Chernobyl power plant accident. In particular, the radioactivity regulation levels for foods (derived intervention levels) adopted in these countries are described in detail, citing from the reports of the Committee on Radiation Protection and Public Health of OECD/NEA (The Radiological Impact of the Chernobyl Accident in OECD Countries) and an scientific seminar held by EC (International Scientific Seminar on Foodstuffs Intervention Levels Following a Nuclear Accident). It is pointed out that these countries rather largely vary in measures taken and the derived intervention levels adopted although the principles for radiation protection which provide the basis for emergency protection measures must be nearly the same in all of the countries. It is necessary to establish consistent standards in each country in consideration of an accident, like the one at Chernobyl, that may have global effects. The ICRP recommendations and IAEA safety guidelines so far are centered on "near-field" measures to be taken in areas near an accident site. Thus, studies should be made to establish measures to be taken in areas far from the site. (Nogami, K.).

7835 **(KURRI-TR—298) Accident of Chernobyl nuclear power plant. Proceedings of the conference on nuclear environmental safety control.** Yoshida, Yoshikazu; Katurayama, Kohsuke; Tsujimoto, Tadashi (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Mar 1988. Vp. (CONF-8708299—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW.

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

Selected papers have been processed for inclusion in the Energy Data Base.

7836 **(NUREG/CR—5219) The mixing of immiscible liquid layers by gas bubbling.** Suo-Anttila, A.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety; Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 43p. (SAND—88-7118). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89003233/JAW.

A mechanistic model of the mixing of two layers of immiscible fluids by gas bubbling is presented. The model is based upon the conceptual framework of a bubble lifting a droplet of heavy fluid into the light fluid and releasing it when the bubble breaks at the upper surface. The model predicts the degree of entrainment for any rate of gas flow. The rate of heat transfer between the two layers is also predicted. Comparison of the model predictions and experimental data is found to be good. A comparison with experiments of an existing correlation by Calderbank for emulsification by aereation is also presented. Applying the model to molten core-concrete interactions indicates that a three-layered concept, heavy oxide/metallic/light oxide, is unstable. A more likely situation would be a completely entrained system or a partially entrained two layer, oxide metallic, system depending upon the gas velocity. 13 refs., 12 figs., 2 tabs.

7837 **(NUREG/CR—5225) An overview of BWR Mark-I containment venting risk implications.** Wagner, K.C.; Dallman, R.J.; Galyean, W.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1988. Contract AC07-76ID01570. 81p. (EGG—2548). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89004067/JAW.

Venting of boiling water reactors with Mark-I containments has been suggested as a way to prevent catastrophic failure and/or mitigate the consequences resulting from a severe accident. Based on phenomenological, human factors, and risk considerations, the potential benefits and downsides of venting Mark-I containments were analyzed. Several generic venting systems and two proposed utility systems were reviewed. Based on generic considerations, the offsite consequences during risk dominant accidents were qualitatively assessed for four different vent systems. A quantitative risk study of an early venting strategy was performed, based on the existing Peach Bottom hardware and the draft NUREG-1150 results for Peach Bottom. Appendices are also included which contain reviews of the Pilgrim and Vermont Yankee venting submitals, a response to the seven questions from the NRC about the Pilgrim venting strategy, and a review of the venting strategy directed by Revision 4 of the Boiling Water Reactor Emergency Procedures Guidelines. 16 refs., 7 figs., 7 tabs.

7838 **(PB—89-851133/XAB) Nuclear-reactor accidents: Chernobyl, TMI, and Windscale. January 1974-September 1988 (Citations from Pollution Abstracts). Report for January 1974-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 51p. NTIS PC N01/MF N01.

This bibliography contains citations concerning studies and measurements of the radiological consequences of nuclear-reactor accidents. The citations cover specifically the Chernobyl reactor in the USSR, the Three Mile Island (TMI) reactor in the US, and the Windscale reactor in the UK. Included are detection and monitoring of the fallout, the resultant runoff into rivers, lakes, and the sea, the radiation effects on people, and the transfrontier radioactive contamination of the environment. (Contains 105 citations fully indexed and including a title list.)

7839 **(PB—89-851141/XAB) Chernobyl nuclear accident: effects on foods. April 1986-October 1988 (Citations from the Food Science and Technology Abstracts data base). Report for April 1986-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 31p. NTIS PC N01/MF N01.

This bibliography contains citations concerning studies and measurements of the radioactive contamination of the Chernobyl nuclear reactor accident of food and food chains. The studies cover meat and dairy products, vegetables, fish, food chains, and radioactive contamination of agricultural farms and lands. (Contains 65 citations fully indexed and including a title list.)

7840 **(SAAS-Mitt—88-01) Guideline on the behaviour in the event of unusual occurences in connection with the use of atomic energy.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. 3-18p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704673/JAW.

This guideline applies to unusual occurences (UOs) relating to radiation protection, nuclear safety, physical protection, and safeguards. It contains provisions for the classification of UOs, contents of notifications of and reports to the National Board for Atomic Safety and Radiation Protection as well as the time limits to be met, shutdown and restart of plants, and technical facilities after UOs, resumption of work by radiation workers and operating personnel after UOs, and investigation of UOs.

7841 **(SAND—88-7119) A theoretical study of the reactions of molten Zr, Fe and Al with water.** Pong, Lichung T. (Sandia National Labs., Albuquerque, NM (USA); Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89002853/JAW.

This report discusses a model for predicting the rates and magnitudes of hydrogen generation as a molten metallic material falls through water. The rate limiting mechanisms considered are hydrogen gas diffusion rate in the steam-hydrogen film and ion diffusion rate in the oxide layer. The model accounts for radiation heat transfer and the heat generated during the chemical reactions. The predicted extent of metal reaction has been compared to the available data of zirconium-water, iron-water and aluminum-water experiments. 22 refs., 20 figs., 6 tabs.

7842 **(UCRL—98542) Structural aspects of the Chernobyl accident.** Murray, R.C.; Cummings, G.E. (Lawrence Livermore National Lab., CA (USA)). 2 Sep 1988. Contract W-7405-ENG-48. 14p. (CONF-8810184—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89001321/JAW.

From Structural Engineers Association of California (SEAOC '88); Kailua-Kona, HI, USA (4 Oct 1988).

On April 26, 1986 the world's worst nuclear power plant accident occurred at the Unit 4 of the Chernobyl Nuclear Power Station in the USSR. This paper presents a discussion of the design of the Chernobyl Power Plant, the sequence of events that led to the accident and the damage caused by the resulting explosion. The structural design features that contributed to the accident and resulting damage will be highlighted. Photographs and sketches obtained from various worldwide news agencies will be shown to try and gain a perspective of the extent of the damage. The aftermath, clean-up, and current situation will be discussed and the important lessons learned for the structural engineer will be presented. 15 refs., 10 figs.

7843 (VTT-SYMP—87, pp 267-278) **Decommissioning of nuclear facilities - R and D activities in Finland. A computer code for modelling transport of radionuclides in the primary system of a PWR nuclear power plant.** Rantanen, J. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

A computer model simulating transport and accumulation of activated corrosion products in the primary system of a pressurized water reactor is described. Some test results are presented and proposed future use of the coe is reviewed shortly.

7844 (VTT-SYMP—87, pp 264-266) **Present status of decommissioning in Finland.** Kukkola, T. (Imatran Voima Oy, Helsinki (Finland)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

In Finland no practical experience is available on the decommissioning of nuclear power plants. All the four nuclear power plants are in operation. The first unit, Loviisa 1, will be decommissioned round about the year 2010. The decommissioning will be financed by the assets collected yearly during power operation of the plants. Decommissioning waste is included in the nuclear waste management policy and it will be treated as the other radioactive plant wastes in Finland.

7845 (VTT-SYMP—87, pp 262-263) **German experiences on decommissioning illustrated by the activities at KRB A nuclear power plant.** Stang, W. 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

The German electricity supply companies have had an investigation carried out to find the most expedient way of decommissioning nuclear power plants at the end of the period of use. Two alternative scemes were proposed for this, safe enclosure of the plant and immediate total removal without safe enclosure. The study confirmed that both alternatives are technically feasible at present, but the latter case is impractical on account of the absence. Decommissioning work is at present going on for 5 German nuclear power stations. For KRB A decommissioning planning was initiated in 1980 and the plan was issued in 1982. Actual decommissioning work began in 1982 and has continued to the present time. Throught 1985, approx. 1500 tons of contaminated materials have been removed from the turbine building. About two thirds of this mass consists of steel and other metals, and one third of concrete and other non-reusable materials. The steel has been decontaminated to release levels and sold on the scrap market. About 400 tons of concrete turbine shielding were removed, decontaminated and released for unrestricted normal disposal. The amount of radioactive waste produced by decommissioning activities in the turbine house remains below 5% of dismantled material.

7846 **(WHC-SA—0344) Contribution to the United States position paper on sodium fires: Design basis and testing.** McCormack, J.D. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 3p. (CONF-8806270—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89001111/JAW.

From International Atomic Energy Agency international working group on fast reactors; Moscow, USSR (6 Jun 1988).

There were four large-scale sodium fire tests completed to provide a data base for computer code validation; three for the ABCOVE program and one for the SOFICOV program. The purpose of the ABCOVE program is to provide a basis for judging the adequacy of existing aerosol behavior computer codes to describe inherent aerosol attenuation in containment buildings during postulated accidents. The program involves both analytical calculations by code developers and users, and large-scale confirmatory tests in the 850-$m^3$ containment vessel of the Containment Systems Test Facility (CSTF) operated by the Westinghouse Hanford Company. A key element of both programs is that all code calculations are made without knowledge of the experimental results, and thus, provide a true measure of the code capabilities without benefit of post-test fitting.

7847 **(EPRI-NP—1850-CCM-A-Vol.1-Rev.4) RETRAN-02: A program for transient thermal-hydraulic analysis of complex fluid flow systems: Volume 1, Theory and numerics (Revision 4).** McFadden, J.H.; Narum, R.E.; Peterson, C.E.; Noble, C.; Farman, R.F.; McClure, J.A.; Paulsen, M.P.; Richert, K.D.; Hughes, E.D.; Gose, G.C. (Electric Power Research Inst., Palo Alto, CA (USA); EI International, Inc., Idaho Falls, ID (USA)). Nov 1988. 866p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004552/JAW.

RETRAN-02 represents a significant achievement in the development of a versatile and reliable computer program for use in best-estimate transient thermal-hydraulic analysis of light water reactor systems. The RETRAN-02 computer program is an extension of the RETRAN-01 program designed to provide analysis capabilities for (1) BWR and PWR transients, (2) small break loss of coolant accidents, (3) balance of plant modeling, and (4) anticipated transients without scram, while maintaining the analysis capabilities of the predecessor code. The RETRAN-02 computer code is constructed in a semimodular and dynamic dimensioned form where additions to the code can be easily carried out as new and improved models are developed. The NRC, at the request of a group of utilities, had Argonne National Laboratory perform a technical review of RETRAN-01 MOD003 and RETRAN-02 MOD002. This review was completed in May 1983, and the NRC issued a Safety Evaluation Report on RETRAN in September 1984. Revision 4 of the RETRAN-02 computer code manuals describes the MOD005 version of the code. This report (the first of a four-volume computer code manual) describes the theory and numerical algorithms of the RETRAN-02 code. The three companion volumes describe the programming details, the user input requirements and sample problem input and output files, and the verification and qualification performed with RETRAN. 186 refs., 75 figs., 30 tabs.

7848 **Sloshing and fluid-structure interaction in a 400-MWe pool-type advanced LMR reactor.** Ma, D.C.; Gvildys, J.; Chang, Y.W. (Reactor Analysis and Safety Div., Argonne National Lab., Argonne, IL (US)). pp 45-56 of Fluid-structure vibration and liquid sloshing. Ma, D.C.; Su, T.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This paper describes the seismic analysis of a 400-MWe advanced fast reactor under 0.3 g SSE ground excitation. Two types of analyses are performed - the sloshing analysis and the fluid-structure interaction analysis. In the sloshing analysis, the sloshing frequency and wave patterns are calculated. The maximum wave height and the sloshing forces exerted on the submerged components and the primary tank are evaluated. In the fluid-structure interaction analysis, the maximum horizontal acceleration for the reactor core and the relative displacement between the reactor core and UIS are examined. The fluid-coupling phenomena between various components are investigated. Seismic stresses at critical areas are examined. The results obtained from this study are very useful to the design of the advanced reactors. Meanwhile, the computer code FLUSTR-ANL has proved to be a useful analytical tool for assessing the complicated seismic fluid-structure interactions and sloshing to the fast reactor system.

7849 **In situ calibration of nuclear plant resistance thermometers using Johnson noise.** Blalock, T.V.; Roberts, M.J.; Shepard, R.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 15.01-15.08 of Proceedings of the industrial temperature measurement symposium. Kerlin, T.W.; Katz, E.M. Knoxville, TN; University of Tennessee at Knoxville (1985). (CONF-8409109—).

From Industrial temperature measurement symposium; Knoxville, TN, USA (10 Sep 1984).

Johnson noise power measuring techniques have been used to calibrate platinum resistance thermometers (PRTs) installed in an operating nuclear plant, achieving agreement with the dc calibration of better than 0.1% or 0.5°F at the normal operating temperature of 585°F. In this application, PRTs with an ice-point resistance of 200 Ω were connected to a test station with 4-wire cables approximately 100 ft long. Methods were developed for in situ cable characterization and quantitative measurement of and correction for non-thermal induced noise.

# 25 ENERGY STORAGE

## 2505 Flywheels

7850 **On the fly or under pressure.** Olszewski, M.; Eisenhaure, D.B.; Beachley, N.; Kirk, J.A. (Engineering Technology Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Waste Age;* **110**: No. 6, 50-59(Jun 1988).

Of the multitude of devices that exist for storing mechanical energy, flywheels and accumulators have a long history of successful application in many areas. Recent advances in flywheels have led to improvements in the specific energy of the rotor, and current high-strain graphite fibers make it reasonable to expect maximum operating speeds of 1200 m/s. With advances in fiber strength, the maximum operating speed may be raised to nearly 1600 m/s. As for accumulators, the use of an elastomeric foam on the gas side reduces thermodynamic losses to the point where "round-trip" efficiencies of 95 percent are possible. Current research will increase the speed and efficiency of these energy storage devices, expanding their potential applications both on earth and in space.

## 2506 Thermal

7851 **(PB—89-110944/XAB) Leaching of rock fractures: laboratory and field tests for borehole heat stores.** Nordell, B.; Hallberg, R.O.; Sjoeberg, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 48p. (D—4:1988). NTIS, PC E03/MF A01.

The aim of the project was to increase the hydraulic conductivity of fractured rock by pumping a leaching fluid (NaOH) through rock fractures. The field test was carried out in a borehole heat store, consisting of 19 vertical boreholes to a depth of 15 m in gneissic rock. The duration of the leachage test was 16 weeks. The idea of the project, that a NaOH solution would leach and thereby widen the fractures, was not fulfilled. On the contrary, the fractures were sealed as the leaching test went on. The explanation to this is that the leaching rate was higher than expected, the leaching fluid was saturated, and the dissolved minerals precipitated. The conclusion of the project is that a leaching of rock as described in the paper should be combined with a deposition tank for the clogging material in order to avoid precipitation in the rock fractures.

## 2509 Batteries

*REFER ALSO TO CITATION(S) 7598*

7852 **(AD-A—197518/4/XAB) High-pressure conductivity and NMR investigation of siloxane-based polymer electrolytes. Interim technical report, 1 October 1987-30 September 1988.** Fontanella, J.J.; Wintersgill, M.C. (Naval Academy, Annapolis, MD (USA). Dept. of Physics). 1988. 14p. (TR—30). NTIS, PC A03/MF A01.

Pub. in Jnl. of Molecular Crystals and Liquid Crystals, 1-11(1988).

Ionic mobility in polymer electrolytes depends critically on the ability of the host polymer to execute segmental motions. Consequently, materials considered for room temperature applications require a relatively low glass transition temperature(Tg). A class of these materials that have recently received considerable attention are those based on copolymers of siloxanes and ethylene oxide. The former constituent provides flexibility to the polymer network which, in addition to enhancing segmental motions, yields desirable mechanical properties. The ethylene oxide(EO) groups provide a polar environment for solvation of the salt. The authors prepared several cross-linked siloxane-EO networks complexed with $NaCF_3SO_3$ which, in turn, were studied by a combination of differential scanning calorimetry (DSC), complex impedance, and Na nuclear magnetic resonance (NMR) techniques. The effects of hydrostatic pressure on electrical conductivity and NMR linewidth were also investigated.

7853 **(AD-A—198254/5/XAB) Impedance studies of the cell Ag/AgI/Ag beta alumina/AgI/Ag. Technical report No. 15, August 1987-August 1988.** Breiter, M.W.; Drstak, H.; Maly-Schreiber, M. (Technische Univ., Vienna (Austria). Inst. fuer Technische Elektrochemie). 1 Jul 1988. 11p. NTIS, PC A03/MF A01.

The construction of the cell Ag/AgI/Ag beta alumina/AgI/Ag is described. The impedance of this cell was measured between .001 and 10000 Hz at temperatures between 20 and 550 C. At temperatures below 100 C the cell impedance is determined to a large extent by the bulk resistance of the AgI layer and to a smaller extent by the impedance of the interface Ag/Agi. At temperatures between 160 and 350 C the impedance is controlled by the bulk resistance of the Ag beta alumina and an impedance due to contact problems between Ag and AgI. The bulk resistance of the beta' alumina becomes predominant between 350 and 550 C. A hindrance due to the transfer of silver ions from AgI to Ag beta' alumina was not observable in the whole temperature range.

7854 **(AD-A—198741/1/XAB) Theoretical modeling of cell and battery characteristics at short times/high frequencies. Interim technical report.** Daroux, M.L.; Cahan, B.D.; Yeager, E.B. (Case Western Reserve Univ., Cleveland, OH (USA). Case Labs. for Electrochemical Studies). 16 Jun 1988. 9p. (TR—2). NTIS, PC A02/MF A01.

The design of batteries intended to delivery very high-current pulses with rise time on the order of microseconds requires consideration of factors usually neglected in conventional battery design. The authors have shown previously that the short time/high-frequency response of a physically large battery may be significantly limited by geometric and physical factors. In constructing theoretical models which can be used to evaluate design factors in pulse batteries it is therefore necessary to take into account the whole battery, the internal and external connections, and eventually

the load itself. On the basis of a modeling study that takes some of these factors into consideration, this paper describes the design implications of geometric and physical variables such as electrodes and electrolyte resistivity, electrolyte thickness, and cell length.

7855 **(AD-A—198971/4/XAB) Study of synchrotron radiation from wet-electrode surfaces. Report for 1 October 1987-30 September 1988.** (IBM Research Lab., San Jose, CA (USA)). 30 Sep 1988. 6p. NTIS, PC A02/MF A01.

The purpose of this project is to experimentally probe and theoretically model the structure of the charged liquid/solid interface. X rays from a synchrotron source are the experimental probe. Direct structural information about selected bonds in the electrode interface is obtained from grazing-incidence fluorescence-detected EXAFS. The absorption near edge structure provides information about the state of oxidation of the adatoms. Information on long range order of adlayers can be obtained from grazing incidence x-ray diffraction. Change in both the structure and the oxidation state as a function of the potential will give information on the inner layer of the electrode interface which has been unavailable until now. Successful in-situ EXAFS experiments were carried out for silver underpotentially deposited on a gold (111) surface and bromide adsorbed on a silver (111) surface. Using in-situ grazing incidence x-ray scattering, the compressibility of a two dimensional lead layer on a silve (111) surface was also measured. One of the purposes of studying Ag on Au (111) was to see whether the Ag-Au distance varies with potential. It did not. Backscattering was also observed from oxygen, which was assigned to water adsorbed as specific sites on the Ag surfaces. The silver-oxygen distance was also constant, independent of potential. The bromide data are being analyzed.

7856 **(AD-A—199035/7/XAB) Advanced calcium thionyl chloride high-power battery. Periodic report No. 2, 23 February-24 June 1988.** Peled, E. (Ramat-Tel-Aviv Univ. Authority for Research and Industrial Development Ltd. (Israel)). 25 Jul 1988. 40p. NTIS, PC A03/MF A01.

Development of two advanced calcium thionyl chloride systems that have much better storage properties than the state-of-the-art Ca-$SOCl_2$ cell is reported. This has been done by replacing the $CaX_2$ (X=$AlCl_4$) electrolyte by $SrX_2$ (type A), or $BaX_2$ (type B). The project's goals are to gain a better understanding of the electrochemistry of the advanced systems and to establish their safety and performance. Results are presented regarding the properties of $MX_2$-sulfur dioxide-TC solutions (M = calcium, strontium, barium), including Raman spectra, viscosity, and conductivity data. The effects of $SO_2$ and temperature on the conductivity and conduction mechanism are explained. The effect of 70 C storage on performance of the baseline (C-size) cell was studied. A fresh cell delivered, at room temperature, 3.4 and 3.2 Ah on 10- and 4-ohm load, respectively. It lost 20% and 55% or more capacity after two and four weeks of storage at 70 C, much more than the type A cell. Short-circuit, heavy-load, and reversal tests of type A cells ended with no cell venting or leaking. Ampule corrosion tests of calcium foils in type A electrolyte reveal 0.5-3% corrosion after four weeks of storage at 70 C. This indicates that a room-temperature shelf life of more than ten years is feasible for the type A system.

7857 **(AD-A—199084/5/XAB) Chemical and physical studies of metal-chalcogenide electrode materials. Final report, 1 August 1982-31 July 1987.** Kannewurt, C.R.; Marks, T.J. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemistry). 29 Aug 1988. 11p. NTIS, PC A03/MF A01.

This project was a collaborative effort at both developing a better understanding of the intercalation process in metal-chalcogenide materials and interactive polymerization in FeOCl with particular attention paid to the influence of hte intercalation chemistry on the electronic properties of the resulting materials. A detailed mechanistic study of the $^2$H-$TaS_2$/pyridine intercalation was carried out under rigorous anhydrous conditions through a thorough study of the redox chemistry which clearly identified the influence on the charge transfer process of even trace amounts of $H_2O$. By intercatively introducing the oxidatively polymerizable pyrrole in the layered FeOCl structure the most conductive, thermally stable, intercalation form of this compound has been prepared. A computer-controlled charge-transport system was specifically developed for conduction studies in these materials that can cover a sample resistance range of zero (the superconductor) to $10^{12}$ ohms.

7858 **(AD-A—199463/1/XAB) Prototype rechargeable lithium batteries. Phase 1. Final report, August 1984-January 1986.** Ebner, W.B.; Lin, H.W. (Honeywell, Inc., Horsham, PA (USA). Power Sources Center). Jun 1987. 144p. NTIS, PC A07/MF A01.

This report details the work performed on Phase I of an overall two-phase program. The aim of Phase I is to select a room-temperature lithium (Li) rechargeable couple that offers high energy density (60-90 Wh/1b), good rate capability (C/6-C/1), and low-temperature operability. Among the four cathode systems investigated - V205, Tis2, v2s5 and LixCo02 - the Li/V2O5 couple emerged as the best performer capable of meeting the performance goals above. The other three cathode systems were dropped from further development during the course of the program because of their general instability with ester-based electrolytes, especially the methyl formate (MF)-based electrolyte. The MF-based electrolyte was selected because of its superior conductivity which is essential for rate capability and low temperature operability.

7859 **(CONF-881061—10) Development of overcharge tolerance in Li/FeS and Li/$FeS_2$ cells.** Kaun, T.D.; Holifield, T.F.; Nigohosian, M.; Nelson, P.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. (CONF-881061—10). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003952/JAW.

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

An innovative application of a self-discharge mechanism for molten-electrolyte Li-alloy/FeS/sub x/ cells has led to the development of overcharge-tolerant cells. Conventional Li-alloy/FeS/sub x/ battery cells require an electronic charger/equalizer. Two versions of the cell have been demonstrated: LiAl+10 Mol% $Li_5Al_5Fe_2$/LiCl-LiBr-KBr (BN, MgO)/$FeS_2$ (operated at 400{degree}C) and LiAl+10 mol% $Li_5Fe_2$/LiF-LiCl-LiBr(MgO)/FeS (operated at 475{degree}C). These cells exhibit a unique combination of overcharge capacity and extended trickle-charge tolerance at 2--5 mA/cm$^2$. The basis for the self-discharge is diffusion of reduced lithium species across the separator by a lithium-shuttle mechanism that is controlled by the Li-activity of the Li-alloy electrode. A bimodal self-discharge rate (a 20-fold increase toward the end of charge) results from a 150--250 mV step increase in Li-activity. Cells having overcharge tolerance have operated with stable performance for greater than 200 cycles. The overcharge tolerance rates are sufficient for battery cells to exhibit built-in charge/equalization capability. 11 refs., 6 figs.

7860 **(CONF-881061—11) Lithium/disulfide cells capable of long cycle life.** Kaun, T.D.; Holifield, T.F.; DeLuca, W.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003947/JAW.

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The lithium-alloy/disulfide cell has undergone improvements to provide a very stable, high performance upper-plateau (UP) $FeS_2$ electrode. Prismatic UP $FeS_2$ cell tests (12--24 Ah capacity) with a LiCl-LiBr-KBr eutectic electrolyte have demonstrated 1000 deep discharge cycles at 400{degree}C with less than a 20% drop in capacity and without reduced power capability. Previous lithium-alloy/disulfide cells, which were based on a two voltage-plateau $FeS_2$ electrode and LiCl-KCl eutectic electrolyte had a life expectancy of only 100 cycles. Both time- and cycle-related capacity loss mechanisms have been eliminated with the improved cell design. In addition, new cell design features of overcharge tolerance and overdischarge safeguarding enhance battery durability. The performance prospects of a Li-alloy/UP $FeS_2$ battery for an IDSEP van application are discussed. A specific energy of 150 Wh/kg for this battery after 1000 cycles of operation is projected. 8 refs., 5 figs., 1 tab.

**7861 (DOE/SF/00115—T14) Physical modeling of bubble phenomena, electrolyte flow and mass transfer in simulated advanced hall cells: Progress report, 1 August 1988--31 October 1988.** Evans, J.W. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Nov 1988. Contract AM03-76SF00115. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003321/JAW.

The objectives of this project are to define mathematically dimensionless numbers, using physical model and specialized apparatus and selected working fluids, to develop quantitative correlations of dimensionless groups, to recommend design, and to predict advanced (low-energy) Hall-Heroult cell performance. 8 figs.

**7862 (EPRI-AP—6012-SR) DOE/EPRI beta (sodium/sulfur) battery workshop VII: Proceedings.** Higgins, J. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1988. 623p. (CONF-8806127—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89003034/JAW.

From 7. DOE/EPRI beta (sodium/sulfur) battery workshop; Toronto, Canada (1 Jun 1988).

This proceedings represents the seventh in the series of DOE and EPRI supported workshops on sodium/sulfur batteries. The 40 technical papers included represent the contributions of all the major groups working on this advanced battery system. In addition, the overviews, which are brief papers representing the status and plans of the developers, of all these groups are also included. Copies of introductions and welcoming addresses are included. The technical papers cover the breadth of the concerns of the field today and include issues of safety, cell development, battery usage, and various social issues.

**7863 (LBL—26159) Modeling and optimization of Li-alloy-metal-sulfide molten salt batteries.** Mason, A.A.; Newman, J. (Lawrence Berkeley Lab., CA (USA)). 28 Sep 1988. Contract AC03-76SF00098. 119p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89002308/JAW.

A computer model for the LiAl/FeS/sub x/ molten-salt battery system (prismatic geometry), which uses input data from experimental test cells, is presented. Optimizations of the negative-to-positive capacity ratio and the number of electrodes per cell are considered. The LiAl/FeS, LiAl/$FeS_2$ (two-plateau operation), and LiAl/$FeS_2$ (upper-plateau operation) battery systems are compared. (Upper-plateau operation refers to complete discharge of $FeS_2$ to $Li_2FeS_2$, and two-plateau operation refers to complete discharge to Fe and $Li_2S$.) While the specific energies are similar for all three systems, the specific power near the end of discharge is highest for the upper-plateau $FeS_2$ system. A similar model for a multi-electrode LiAl/$FeS_2$ cylindrical cell (upper-plateau operation) is also presented. A simplified version of this model, which does not account for the bus and post resistances, is used to show that the experimental data currently available in the literature are not appropriate for use with this model. In spite of this disappointing conclusion, the effects of the positive current collector radius, the cell height, and the number of positive electrodes on specific energy and specific power are examined. 43 refs., 19 figs., 3 tabs.

**7864 (PB—88-870597/XAB) Lithium batteries. January 1970-October 1988 (Citations from the US Patent data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 48p. NTIS PC N01/MF N01.

Supersedes PB—87-867941.

This bibliography contains citations of selected patents concerning lithium batteries and cells, and their application as power sources in electronic and electric devices. Electrode, electrolyte, and sealing materials used in the manufacture of lithium batteries are discussed. Additives used for stabilization, and safety control methods are also considered. (This updated bibliography contains 100 citations, 14 of which are new entries to the previous edition.)

**7865 (PB—89-851802/XAB) Battery additives. January 1970-November 1988 (Citations from the Compendex data base). Report for January 1970-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 64p. NTIS PC N01/MF N01.

This bibliography contains citations concerning compositions added to battery solutions such as organic or inorganic salts. These additives may act as antipoisoning agents, or regeneration agents. They improve battery performance by increasing the discharge rate. Studies of battery performance in the presence of specific additives is included. (Contains 120 citations fully indexed and including a title list.)

**7866 (SAND—88-0901C) Characterization of poly(vinyl chloride) aged in a bromine containing electrolyte.** Arnold, C. Jr.; Leo, A.; Tarjani, M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880912—2). NTIS, PC A03/MF A01 - OSTI. Order Number TI88008338/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

Poly(vinyl chloride) (PVC) is being considered for use as a flow frame material in a developmental zinc/bromine battery. The choice of PVC was based on its low cost and the ease with which it can be molded into complex parts. The electrolyte used in this battery is a highly corrosive mixture of bromine, zinc bromide, zinc chloride, potassium bromide, potassium chloride and a quaternary amine salt. The quaternary salt serves to reduce the concentration of free bromine in the electrolyte by virtue of its complexing capability. It is well known that aqueous bromine is capable of oxidizing organic compounds. The purpose of the current study was to investigate the effect of a bromine electrolyte on two PVC formulations, PVC-1 and PVC-4. PVC-1 is the designation given to one of B.F. Goodrich's commercial formulations and is the present baseline material for the flow frame. PVC-4 is an experimental B.F. Goodrich formulation that was developed especially for battery applications. We sought answers to such questions as (1) does oxidation and/or bromination take place? (2) does bromine penetrate into the sample and, if so, how far? (3) how are the mechanical and morphological properties affected? and (4) are there differences in stability between PVC-1 and PVC-4? To accelerate the aging processes we aged the PVC samples at an elevated temperature in an electrolyte which did not contain any complexing agent. 5 refs., 6 figs.

# 29 ENERGY PLANNING AND POLICY

**7867 (CRIE-Y—88005) Economy and energy in developing countries. Case of Thailand.** Kumakura, Osamu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1988. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755737/JAW.

In this case study on Thailand which is classified as a middle-income oil importing country, the energy situation and policy issues are examined in general in the broader context of economic development of developing countries achieving the sustained rapid growth. On the demand side, the energy consumption are based widely (especially in domestic demand and rural light industrial uses) on traditional resources and techniques, and remaines more space to improve with efficient and modernization. And the energy conservation to govern the energy demand, expected to continue with rapid growth, becommes more important in the political strategy. For the supply side, domestic energy resources have been developed positively. Consequently, the supply of natural gas and lignite rapidly increased at the first half of the decade of 1980. And as the fundamental condition to the government policy, correct pricing of energy is pursued to promote efficiency in energy supply and consumption, and reinforcement of international conpetitiveness in economies are aimed. (7 figs, 14 tabs, 15 refs)

**7868 (DOE/MA—0334-2) Quarterly status of Department of Energy projects.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). 30 Jun 1988. 289p. NTIS, PC A16/MF A01 - OSTI. Order Number DE89003387/JAW.

This "Quarterly Status of Department of Energy Projects" is prepared by the Office of Project and Facilities Management. It presents cost and schedule information for all projects in the design or construction phase. The information is current as of June 30, 1988. This report uses a format generated by a microcomputer-

based system (Automated Reporting System) using electronic transmissions from the field offices. Additionally, it incorporates many suggestions received from Program and Field Offices, such as extended source identification for much of the reported data. All currently approved projects are included. Data for new projects will be added as it becomes available.

## 2901 Energy Analysis And Modeling

*REFER ALSO TO CITATION(S) 7931, 7998, 7999*

7869 **(ESC-WR—88-23) Chances for new energy technologies in the Netherlands. Overall results of the EOS-study.** Boswinkel, H.H.; Gerbers, D.; Kram, T.; Lako, P.; Okken, P.A.; Tiemersma, D.N. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Sep 1988. 79p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Energy Study Centre, Netherlands, carried out a study with the aim to identify interesting long-term energy research areas. The most important results are presented as well as the starting points and the operating method of the study. Firstly an overall description is given of the scenarios and variants (energy demand, import prices, supply limitations, emission limits), the operation of the linear programming model MARKAL and the most important results with regard to the input of energy resources and the costs of the energy supply. Then different energy technologies are considered for their possibilities to play a part in the Dutch energy economy in the long term. Finally the substitution of different competitive technologies under the influence of variations in energy prices and environmental demands are discussed. 28 figs., 6 refs., 10 tabs.

7870 **(ESC-WR—88-26) DELPE, a multi-period LP-model, containing a set non-linear cost functions, for the Dutch energy system.** Van Oostvoorn, F.; Van Dasler, H.C.; Den Hengst-Van der Hoek, H. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1988. 49p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Energy Study Centre (ESC) is involved in energy and environmental policy and scenario studies for the Ministry of Economic Affairs and the Ministry of Environment. A dynamic multi-period LP optimization model called DELPE (Dynamic ESC Linear Programming Energy model) is described. The multi-period LP model to be solved, contains a set of non-linear cost functions for oil and natural gas extraction and for electricity generating capacity expansion. The non-linear cost functions for electricity generation are partly solved by the Mixed Integer Programming option, available in the CDC LP solution code Apex III. 17 figs., 16 refs., 2 tabs.

7871 **(NP—9770159) Danish energy model and its applicability to the Federal Republic of Germany. 2. enlarged ed.** Krawinkel, H. (Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.)). Dec 1987. 216p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE89770159/JAW.

Chapter 1 discusses the economic and social boundary conditions as well as the energy economy and energy policy of Denmark. Chapter 2 comprehensively summarizes the methods and aims of energy models. Chapter 3 presents the results of the energy models put into practice so far and gives an outlook on what is planned for the future. Chapter 4 evaluates both energy models on the basis of given energy policy strategies and the vehicles and measures applied. Chapter 5 deals with the applicability of the Danish model to the Federal Republic of Germany and, differentiating between the organization of the sovereign planning system on one hand and the set-up of an information system on the other hand, tries to evaluate the relevant legal and organizational conditions. Chapter 6 sums up the major aspects and experiences of Danish energy policy and deduces a number of recommendations and suggestions suited for the Federal Republic of Germany.

## 2902 Economics And Sociology

*REFER ALSO TO CITATION(S) 7330, 7350, 7870, 7929, 7930, 7933, 7936, 7937, 7938, 7942, 7954, 7982, 8055, 8069, 8798, 8799, 8801, 8839, 9423, 9470*

7872 **(AD-A—198448/3/XAB) Efficient and competitive rationing. Technical report.** Wilson, R. (Stanford Univ., CA (USA). Inst. for Mathematical Studies in the Social Sciences). May 1988. 67p. (TR—528). NTIS, PC A04/MF A01.

The contracts of interest here are called priority-service contracts. The salient feature of such contracts is that they specify each customer's priority in obtaining service. That is, they specify the task order in which a customer is served out of the available supply, until all customers are served or supply is exhausted. Such contracts essentially establish queues for customers. In Section 1 the author provides some background about priority service. Section 2 formulates a basic model and offer several illustrations. Also describes two main examples that motivate the theoretical development. Section 3 derives some key results that show how the prices of priority-service contracts are designed to induce customers to self-select efficient service orders. In Section 4 the author discusses various ways that state enterprises can organize markets that implement priority service efficiently. In Section 5 the operation of competitive markets for priority service is studied. Section 6 concludes with some summary remarks. Two themes are emphasized. One is that a state enterprise can promote substantial efficiency gains by substituting priority service for absent spot markets. The other is that oligopolistic firms may have insufficient incentives to offer efficient product diversity; consequently, allocative efficiency depends on entry of numerous firms. Even so, dispersal of supplies among many firms can prevent productive efficiency when there are advantages from pooling supplies.

7873 **(CONF-881011—33) The ANS/ENS international student exchange program.** Bornstein, I. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004205/JAW.

From Joint meeting of the European Nuclear Society and the American Nuclear Society; Washington, DC, USA (30 Oct 1988).

This program, called the ANS/ENS International Student Exchange Program, sponsors bilateral exchanges of engineering graduate students from universities located in the midwestern part of the United States with those from universities in France, West Germany and Japan. The American students are provided with summer jobs at leading research centers in France, West Germany and Japan. And, in turn, the students from those countries come to the United States to work at the Argonne National Laboratory. The Exchange Program has provided enriching experiences for nearly 100 American students and an equal number of students from abroad. These young men and women not only learn how technical work is conducted in a foreign country, they also learn about the people and their customs. When the students arrive to begin their assignments, they are usually strangers in a foreign culture. By the time they leave, they've become acquainted with the people, have formed strong bonds of friendship; and, in a small way, have helped foster international good and will understanding. 11 figs.

7874 **(CRIE-Y—87011) Development of a modeling and simulation system for large-scale economic models (Part 1). System design and development of basic components.** Matsui, Shoichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755735/JAW.

The system design and basic components of the subsystem for the large scale medium range economic forecast system capable of forecasting continuously from the world energy supply and demand to Japanese regional economics were designed and developed. The subsystem was possible to support efficiently analysts or model-builders from model building to simulation and to handle systmematically even existing models. The basic components con-

sisted of following systems: a system supporting model-builders in the estimation process of structural equations, a simulation system linking arbitrary model blocks into a balanced model and calculating at high speed, a system showing the forecasting results in graphs or tables. The remarkable improvement of operational efficiency was confirmed as for two quantitative models developed by the subsystem, and the simulation of large scale models incapable of processing by the exsisting system were also possible to be done at high speed by the subsystem. The improvement of model development efficiency is remained for future studies. (4 figs, 14 refs)

7875 **(ESC-WR—88-20) The competition position of absorption heat pumps.** Boswinkel, H.H.; Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Sep 1988. 62p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

For small heat pumps it is investigated in what way market parameters and cost price influence the market scope of the heat pumps. In the EOS-project calculations were carried out with the help of the Markal model for the period 1980-2020 for three socially based scenarios. The results of the scenario 'Dynamics and Growth' are highlighted. Variations in the input of gas-fueled absorption heat pumps (AHP's) in the different market segments were reached by changes of the scenario starting points. By means of sensitivity analysis the influence of energy expenses, environmental demands, discount rate, scenario choice and higher investment costs, on the market share of small and medium AHP's (4 kW/sub th/ and 40-200 kW/sub th/) has been investigated. Both market groups have an annual heat demand of 200-250 PJ. The two types AHP's obtain a similar market share which increases according to the calculations to about 30% in the year 2020. For twice the investment costs for the AHP this market share disappears. For the other variants, which will be discussed separately, an apparent market share remains. In the appendices relevant technical-economical starting points in the EOS-study for heat pumps and insulation of buildings are presented. 24 figs., 20 refs., 6 tabs., 2 app.

7876 **(Juel-Spez—426) Discount rate in the planning of medium- to long-term projects in the energy sector.** Erdmann, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Jan 1988. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756114/JAW.

The interrelation between the time requirement of technical systems - in the case under discussion it is a question of the lead time for investments in the energy sector as well as the lifespan of individual energy systems - and the time-related behaviour of the decision-makers is shown in the problem of the discount rate. Time provision for economic projects is reflected in the time preference rate, which can deviate from the market rate of interest under precisely definable conditions. The present study shows that these facts present a fundamental problem not only for energy planning but also for the relationship between the market economy and democracy.

7877 **(PB—89-103212/XAB) Baseline socio-economic profiles of coastal counties in the northern California planning area. Final report, 1970-2020.** Brown, G.; Kolp, P.; Wallace, B. (Kearney (A.T.), Inc., Alexandria, VA (USA)). Oct 1987. 457p. NTIS, PC A20/MF A01.

See also PB—89-103238.

The report presents baseline socio-economic profiles of Del Norte, Humboldt, and Mendocino Counties in northern California. It is one of six reports prepared under the contract to develop baseline socio-economic profiles of coastal counties in California, Oregon and Washington. The profiles cover demographics, economics, housing, public services and facilities, public finance, energy consumption, land use, and port capacity, marine traffic, and fishing. Secondary sources were used to prepare the profiles. The focus of the profiles is 1980, but 1970 to 2020 is covered to the extent possible with existing data.

7878 **(PB—89-103220/XAB) Baseline socio-economic profiles of coastal counties in the central California planning area. Final report, 1970-2020.** Brown, G.; Kolp, P.; Wallace, B. (Kearney (A.T.), Inc., Alexandria, VA (USA)). Oct 1987. 907p. NTIS, PC A99/MF E04.

See also PB—89-103212.

The report presents baseline socio-economic profiles of Sonoma, Marin, San Francisco, San Mateo, Santa Cruz, and Monterey Counties in central California. It is one of six reports prepared under the contract to develop baseline socio-economic profiles of coastal counties in California, Oregon, and Washington. The profiles cover demographics, economics, housing public services and facilities, public finance, energy consumption, land use, and port capacity, marine traffic, and fishing. Secondary sources were used to prepare the profiles. The focus of the profiles is 1980, but 1970 to 2020 is covered to the extent possible with existing data.

7879 **(PB—89-103238/XAB) Baseline socio-economic profiles of coastal counties in the southern California planning area. Final report, 1970-2020.** Brown, G.; Kolp, P.; Wallace, B. (Kearney (A.T.), Inc., Alexandria, VA (USA)). Oct 1987. 600p. NTIS, PC A25/MF A01.

See also PB—89-103220.

The report presents baseline socio-economic profiles of Los Angeles, Orange, and San Diego Counties in southern California. It is one of six reports prepared under the contract to develop baseline socio-economic profiles of coastal counties in California, Oregon, and Washington. The profiles cover demographics, economics, housing, public services and facilities, public finance, energy consumption, land use, and port capacity, marine traffic, and fishing. Secondary sources were used to prepare the profiles. The focus of the profiles is 1980, but 1970 to 2020 is covered to the extent possible with existing data.

## 2903 Environment, Health, And Safety

*REFER ALSO TO CITATION(S) 7199, 7338, 7430, 7432, 7433, 7495, 7573, 7618, 7619, 7620, 7715, 7718, 7902, 7959, 7960, 8043, 8054, 8743, 8798, 8799, 8800, 8801, 8839, 9243, 9272, 9279, 9280, 9281, 9282, 9283, 9284, 9286, 9287, 9333, 9334, 9335, 9336, 9337, 9338, 9347, 9354, 9355, 9369, 9375, 9384, 9404, 9405, 9406, 9407, 9408, 9409, 9410, 9411, 9412, 9413, 9414, 9415, 9416, 9417, 9418, 9419, 9420, 9421, 9422, 9423, 9424, 9425, 9470, 9471, 9505, 9546, 9547, 9558, 9559, 9601*

7880 **(AD-A—197417/9/XAB) Installation-Restoration Program. Preliminary assessment; records search for the 155th Tactical Reconnaissance Group, Nebraska Air National Guard, Lincoln Municipal Airport, Lincoln, Nebraska.** (Hazardous Materials Technical Center, Rockville, MD (USA)). Nov 1987. 106p. NTIS, PC A06/MF A01.

The Hazardous Materials Technical Center (HMTC) was retained in May 1986 to conduct the Installation-Restoration Program (IRP) Preliminary Assessment (PA) - Records Search for the 155th Tactical Reconnaissance Group (TRG), Nebraska Air National Guard, Lincoln Municipal Airport, Lincoln, Nebraska (hereinafter referred to as the Base). The Records Search included: an onsite visit including interviews with 19 Base personnel conducted by HMTC personnel on 21-23 May 1986; the acquisition and analysis of pertinent information and records on hazardous materials use and hazardous-waste generation and disposal at the Base; the acquisition and analysis of available geologic, hydrologic, meteorologic, and environmental data from pertinent Federal, State, and local agencies; and the identification of sites on the Base that may be potentially contaminated with hazardous materials/hazardous wastes (HM/HW).

7881 **(AD-A—197418/7/XAB) Installation-Restoration Program; preliminary assessment for the 165th Tactical Airlift Group and Savannah Permanent Field Training Site, Georgia Air National Guard, Savannah International Airport, Savannah, Georgia.** (Hazardous Materials Technical Center, Rockville, MD (USA)). Dec 1987. 107p. NTIS, PC A06/MF A01.

The Hazardous Materials Technical Center (HMTC) was retained in May 1987 to conduct the Installation-Restoration Program (IRP) Preliminary Assessment of the 165th Tactical Airlift Group

(TAG) and the Savannah Permanent Field Training Site (PTFS) of the Georgia Air National Guard (ANG), Savannah International Airport, Savannah, Georgia (hereinafter referred to as the Base). The Preliminary Assessment included: an onsite Base visit, including interviews with 26 past and present base employees and conducted by HMTC personnel during 18-21 May 1987; the acquisition and analysis of pertinent information and records on the use of hazardous material and generation and disposal of hazardous waste at the Base; the acquisition and analysis of available geologic, hydrologic, meteorologic, and environmental data from pertinent Federal and State agencies; and the identification of sites on the Base which may be potentially contaminated with hazardous material/hazardous waste (HM/HW).

7882 **(AD-A—197419/5/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1 for United States Air Force Plant Number 59, Johnson City, New York. Appendices. Final report.** (Hart (Fred C.) Associates, Inc., New York (USA)). Mar 1988. 358p. NTIS, PC A16/MF A01.

The overall objective of the Installation-Restoration Program (IRP) Phase II investigation is to assess potential contamination at past hazardous-waste disposal and spill sites on Air Force installations. A series of staged field investigations may be required to meet this objective. The intention of this staged investigation is to undertake a field and laboratory study at Air Force plant 59, Johnson City NY: (1) to confirm the presence or absence of contamination within the specified areas of investigation; (2) if possible, to determine the extent and degree of contamination and the potential for migration of those contaminants in the various environmental media; (3) to identify public health and environmental hazards of migrating pollutants based on State or Federal standards for those contaminants; and (4) to delineate additional investigations required beyond this stage to reach the Phase II objectives. The Phase I IRP Report incorporates the background and description of the sites/zones for this task.

7883 **(AD-A—197430/2/XAB) Installation-Restoration Program. Preliminary assessment for the 153rd Tactical Airlift Group, Wyoming Air National Guard, Cheyenne Municipal Airport, Cheyenne, Wyoming.** (Hazardous Materials Technical Center, Rockville, MD (USA)). Mar 1988. 65p. NTIS, PC A04/MF A01.

The Hazardous Materials Technical Center (HMTC) was retained in September 1987 to conduct the Installation-Restoration Program (IRP) Preliminary Assessment of the 153rd Tactical Airlift Group (TAG), Wyoming Air National Guard, Cheyenne Municipal Airport, Cheyenne, Wyoming. The Preliminary Assessment included: an onsite visit, including interviews with 15 present and past Base personnel and 2 airport personnel conducted by HMTC personnel during 13-16 October 1987; the acquisition and analysis of pertinent information and records on hazardous materials use, and hazardous-waste generation and disposal at the Base; the acquisition and analysis of available geological, hydrological, meteorological development, and environmental data from pertinent Federal, State, and local agencies; and the identification of sites on the Base that may be potentially contaminated with hazardous materials/hazardous wastes (HM/HW). Past Base operations involved the use and disposal of materials and wastes that subsequently were categorized as hazardous. The major operations of the 153rd TAG that have used and disposed of these materials and wastes are flightline, NDI, avionics, AGE, airframe, electrical, engine and propulsion, nose dock and fuel cell, phase dock, pneudraulics, POL and refueling, repair and reclamation, photography lab, clinic, and vehicle maintenance. Waste oils, recovered fuels, spent cleaners, strippers, photographic chemicals, acids, and solvents were generated by these activities.

7884 **(AD-A—197434/4/XAB) Installation-Restoration Program. Preliminary assessment for 122nd Tactical Fighter Wing, Indiana Air National Guard, Fort Wayne Municipal Airport, Fort Wayne Indiana.** (Hazardous Materials Technical Center, Rockville, MD (USA)). Apr 1988. 75p. NTIS, PC A04/MF A01.

The purpose of this Preliminary Assessment is to identify and evaluate suspected problems associated with past hazardous-waste handling procedures, disposal sites, and spill sites on the Base. Personnel from the Hazardous Materials Technical Center (HMTC) visited the Base, reviewed existing environmental information, analyzed the Base records concerning the use and generation of hazardous material/hazardous waste (HM/HW), and conducted interviews with Base personnel who are familiar with past and present HM/HW management activities. The scope of this Preliminary Assessment is limited to the Base and includes: Onsite visit; acquisition of pertinent information and records on hazardous-materials use and hazardous-wastes generation and disposal practices at the Base; acquisition of available geologic, hydrologic, meteorologic, land use and zoning, critical habitat, and utility data from various Federal, State, and local agencies.

7885 **(AD-A—197435/1/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Final report, May-September 1984.** (Weston (Roy F.), Inc., West Chester, PA (USA)). 28 Mar 1986. 250p. NTIS, PC A11/MF A01.

A Problem Confirmation Study was conducted at Burlington Air National Guard Base in Vermont. The study included two sites: Site 1, a former Fire Department training area/old landfill, and Site 2, a construction-rubble landfill. Five new monitor wells were installed at Site 1. Ground-water samples were collected from the new monitor wells and from three existing monitor wells at Site 1, and surface-water samples were collected from both sites. On the basis of water-quality data collected in this investigation, both sites were confirmed as potential sources of contamination. Recommendations have been made for monitoring at Site No. 2, and a site-characterization study to assess the magnitude and extent of contamination at Site No. 1.

7886 **(AD-A—198424/4/XAB) Defense Environmental Restoration Program; annual report to Congress for Fiscal Year 1987. Final report, October 1986-September 1987.** (Office of the Deputy Assistant Secretary of Defense (Environment), Washington, DC (USA)). 1 Mar 1988. 109p. NTIS, PC A06/MF A01.

This is the second annual report to the Congress on the Defense Environmental Restoration Program. It responds to the information requested in sections 120 and 211 of the Superfund Amendment and Reauthorization Act (SARA) of 1986. The report explains and gives the current status of: (a) Installation-Restoration Program, (b) Other Hazardous-Waste Operations, and (c) Building Demolition and Debris Removal. Progress at NPL sites is included along with an explanation of the process. The second part of the report provides specific information requested in SARA concerning progress at specific sites.

7887 **(INIS-mf—11855) On environmental problems in Poland.** Hinkel, H.; Kenez, C.J. (eds.). (Johann-Gottfried-Herder-Institut, Marburg (Germany, F.R.)). Jun 1987. 210p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755960/JAW.

Dokumentation Ostmitteleuropa. Wissenschaftlicher Dienst fuer Ostmitteleuropa. Neue Folge.; v. 13(37)(2/3).

The book contains articles by five authors on the following subjects: General literature in German and Polish language on environmental problems in Poland; legal issues of environmental protection - laws for the protection and development of the environment; environmental health hazards - hazards at work; protection of the sea environment in the region of the Baltic Sea - pollution of the Baltic Sea; the water situation in Poland - the large-scale project 'Weichsel 2000'; the ecological situation of the lakes of Masovia; air pollution and its effects - the dying of Silesian forests; Chernobyl and the Polish reaction; the 27 ecologically endangered areas in Poland. (HSCH).

7888 **(PB—88-249099/XAB) Love Canal Emergency Declaration Area habitability study.** (CH2M Hill Southeast, Inc., Reston, VA (USA)). 1988. 1084p. NTIS, PC E99/MF E99.

Set includes PB—88-249107 through PB—88-249149.

A separate abstract is included for each of the 5 volumes of this set.

7889 **(PB—88-249115/XAB) Love Canal Emergency Declaration Area habitability study. Volume 2. Air assessment: indicator chemicals. Final report.** (CH2M Hill Southeast, Inc., Reston, VA (USA)). Feb 1988. 60p. NTIS, PC A04/MF A01.

See also Volume 1, PB—88-249107 and Volume 3, PB—88-249123. Errata sheet inserted; Also available in set of 5 reports PC E99, PB—88-249099.

Environmental studies were conducted to provide data that could be used by the Commissioner of Health for the State of New York in determining whether the Emergency Declaration Area (EDA) surrounding the Love Canal hazardous-waste site is habitable. An air assessment was conducted for Love Canal Indicator Chemicals. Homes throughout the EDA were sampled using the Trace Atmospheric Gas Analyzer Model 6000E.

7890 **(PB—88-249123/XAB) Love Canal Emergency Declaration Area habitability study. Volume 3. Soil assessment: indicator chemicals. Final report.** (CH2M Hill Southeast, Inc., Reston, VA (USA)). May 1988. 347p. NTIS, PC A15/MF A01.

See also Volume 2, PB—88-249115 and Volume 4, PB—88-249131. Errata sheet inserted. Portions of this document are not fully legible; Also available in set of 5 reports PC E99, PB—88-249099.

Environmental studies were conducted to provide data that could be used by the Commissioner of Health for the State of New York in determining whether the Emergency Declaration Area (EDA) surrounding the Love Canal hazardous-waste site is habitable. The soil assessment compared concentrations of the Love Canal Indicator Chemicals found in the EDA to concentrations found in similar western New York communities. An analytical technique was developed to detect the indicator chemicals at very low levels, i.e. 1.0 ppb. The analytical technique utilized a gas chromatograph/mass spectrometer operating in the selected ion monitoring mode. The analytical results were statistically compared between the EDA and the comparison areas using a modified Wilcoxon rank sum test.

7891 **(PB—88-249131/XAB) Love Canal Emergency Declaration Area habitability study. Volume 4. Soil assessment: 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin). Final report.** (CH2M Hill Southeast, Inc., Reston, VA (USA)). Mar 1988. 88p. NTIS, PC A05/MF A01.

See also Volume 3, PB—88-249123 and Volume 5, PB—88-249149; Also available in set of 5 reports PC E99, PB—88-249099.

Environmental studies were conducted to provide data that could be used by the Commissioner of Health for the State of New York in determining whether the Emergency Declaration Area (EDA) surrounding the Love Canal hazardous-waste site is habitable. A soil assessment for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) was conducted to determine whether the soil in the EDA contains 2,3,7,8-TCDD at levels above the level of concern set by the Centers for Disease Control: 1.0 ppb. Samples of surface soil were collected at 2,274 locations throughout the EDA.

7892 **(PB—88-249149/XAB) Love Canal Emergency Declaration Area habitability study. Volume 5. Peer review summary: TRC (Technical Review Committee) responses. Final report.** (CH2M Hill Southeast, Inc., Reston, VA (USA)). Jul 1988. 506p. NTIS, PC A22/MF A01.

See also Volume 4, PB—88-249131; Also available in set of 5 reports PC E99, PB—88-249099.

Environmental studies were conducted to provide data that could be used by the Commissioner of Health for the State of New York in determining whether the Emergency Declaration Area surrounding the Love Canal hazardous-waste site is habitable. These volumes (II through IV) were reviewed by a peer-review panel of expert scientists. The scientists concluded that each of the three environmental studies was well planned and well executed. Volume V summarizes the peer review and gives additional information or clarifications as requested during the peer review. Volume V also provides additional supplemental statistical analyses requested by the peer reviewer panel.

7893 **(PB—89-100184/XAB) Nature and extent of lead poisoning in children in the United States: a report to Congress. Final report.** Mushak, P.; Crocetti, A.F. (Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA)). Jul 1988. 563p. (DHHS—99-2699). NTIS, PC A24/MF A01.

The findings in this report clearly indicate a continuing health concern that too many children are exposed to too much lead in their environments. About 17% of children in Standard Metropolitan Statistical Areas are exposed to environmental sources of lead at concentrations that place them at risk of adverse health effects (using a blood lead criterion of 15 micrograms of lead per deciliter of blood). Three to four million children are estimated to have this level of risk. Additionally, 400,000 fetuses are estimated to be at risk of excess absorption of lead due to maternal exposure. Lead in paint and lead in dust/soil will continue as major problems into the foreseeable future. These sources of exposure to lead remain, in large measure, as problems of poor housing and impoverished neighborhoods. The report recommends effective use of screening programs to prevent development of adverse health effects in children exposed to environmental sources of lead. The most-effective prevention measure will be removal or marked reduction of lead-exposure sources. The report contains an extensive bibliography.

7894 **(PB—89-102594/XAB) Resource Conservation and Recovery Act Subtitle C - Hazardous Waste Management, Section 3001 and 250.14-Infectious Waste: background document. Draft report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 15 Dec 1978. 126p. (EPA—530/SW-88-055). NTIS, PC A07/MF A01.

The report provides background information and support for regulations which have been designed to identify and list hazardous waste pursuant to Section 3001 of the Resource Conservation and Recovery Act of 1976. The report also presents the Agency's rationale in determining the definition of infectious hazardous waste.

7895 **(PB—89-108195/XAB) Monitoring and managing environmental impact: American and Soviet perspectives.** Schweitzer, G.E.; Phillips, A.S. (National Research Council, Washington, DC (USA)). Jan 1988. 292p. NTIS, PC A13/MF A01.

At the request of the U.S. Environmental Protection Agency, the National Academy of Sciences hosted a U.S.-USSR bilateral symposium in December 1986 (Comprehensive Analysis of the Environment). The meeting was fifth in a series of symposia on the topic and was part of an ongoing project within the framework of the Intergovernmental Agreement on Cooperation in the Field of Environment Protection between EPA and the USSR State Committee for Hydrometeorology and Control of the Natural Environment (Hydromet). The symposium's goal was to help clarify the various factors that influence the quality of the environment, including the impact of pollutants on the ecosystem and human health, the influence of human activity on the biosphere, and the scientific basis for determining ecological resilience. A general session addressed approaches and basic concepts, while technical sessions covered such topics as monitoring approaches and technology, regional-scale case studies, management applications, and global monitoring strategies. Future directions for joint research were discussed at the closing session.

7896 **(PB—89-114144/XAB) ROD (record of decision) annual report, FY 1987.** (Environmental Protection Agency, Washington, DC (USA)). Jul 1988. 240p. NTIS, PC A11/MF A01.

See also report for FY 1986, PB—87-199550.

The report is a record of decision. It described the situation of pollution, the remedial action what is selected and the estimated capital cost for the remedy in the Davis Liquid Waste site and the Ottati and Goss/Great Lakes Container Corporation site (GLCC).

7897 **(PB—89-116032/XAB) Methodological challenges in health risk assessment. Final report.** (Lewin and Associates, Inc., Washington, DC (USA)). 12 Oct 1987. 466p. NTIS, PC A20/MF A01.

Risk assessment, a major activity of both health and regulatory agencies, is subject to large and unavoidable uncertainties. Thus, different teams of knowledgeable experts can come to different conclusions about risks to human health from various sorts of hazards. This report examines and compares analyses by two or more agencies of ten health hazards or potential hazards: ethylene dibromide, formaldehyde, Tris, dioxin (limited to cancer risks of contaminated soil), lead (reproductive effects), cotton dust, noise (long-term hearing impairment), passive smoking, dietary fat (cancer risks), and the radiation hazards of mammography. Each set of risk assessments is analyzed in depth. The report then turns to cross-cutting analyses of such matters as setting priorities for risk assessment, approaches and methods used to evaluate different kinds of risks, and the relationships between risk assessment and risk management. Overall, the report found large differences among risk assessments of the same hazard, but these differences are often quite appropriate.

7898 **(PB—89-116065/XAB) Environmental fate data base (ENVIROFATE): chemical name file (CASLST), June 1988. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Jun 1988. mag tap. NTIS CP T02.

Supersedes PB—87-186490. Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products.

The tape includes the chemical name, molecular formula, and CAS registry number for each chemical added to the ENVIROFATE data base by these supplements. The tape is to be used in conjunction with DATALOG, BIOLOG, and CHEMFATE. The CASLST file consists of three fields: (1) Chemical Abstract Service Registry Number (CAS) which is numerical and 9 bytes in length; (2) Chemical formula (FOR) which is textural and 23 bytes in length; and (3) Chemical name (CNA) which is textural and 48 bytes in length.

7899 **(PB—89-116081/XAB) Environmental fate data base (ENVIROFATE): environmental fate data (DATALOG), June 1988. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Jun 1988. mag tap. NTIS CP T02.

Supersedes PB—87-186508. Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products.

DATALOG is a bibliographic pointer file of environmental fate data and each record contains a chemical CAS registry number (9 bytes), one of 18 data types (9 bytes), and a reference number (6 bytes) to the full citation in the XREF file. The data types identify physical properties, degradation and transport studies, and food, occupational and ambient monitoring data. The file should be used with CASLST (in order to link the full reference citation). A list of possible data types and their abbreviations are: Adsorption (ADSORP), Bioconcentration (BIOCON), Biodegradation (BIODEG), Dissociation constant (DISS CON), Ecosystem (ECOS), Effluent concentrations (EFFL), Evaporation from water (EVAP), Food and crop concentrations (FOOD), Field studies (FIELD), Henry's Law constant (HENRY CON), Hydrolysis (HYDROL), Monitoring (MONIT), Occupational concentrations (OCCUP), Octanol/water partition coefficient (O/W PART), Photoxidation (PHOTOOXID), UV Spectra (UV), Vapor pressure (VP) and Water solubility (WATER SOL).

7900 **(PB—89-116099/XAB) Environmental fate data base (ENVIROFATE): microbial degradation/toxicity data (BIOLOG), June 1988. Data file.** Boethling, R. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Jun 1988. mag tap. NTIS CP T02.

Supersedes PB—87-186516. Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products.

BIOLOG is a bibliographic pointer file of microbial biodegradation/toxicity data. Each record contains a Chemical Abstract Services Registry Number (9 bytes), a string of data codes (total of 10 bytes) and a reference number (6 bytes). The string of data codes is divided into: (1) an indication of biodegradation (B) or microbial toxicity (T) data (1 byte); (2) oxygen condition- aerobic (AE) or anaerobic (AN) (2 bytes); (3) culture type-pure enzyme (PE), pure culture (PC), mixed culture (MC), or cell-free extract (CF) (2 bytes); (4) source of micro-organism- soil (SOI), sediment (SED), sewage (SEW) fresh water (WAF), marine water (WAM) or other (OTH) (3 bytes); (5) whether the pathway of degradation was (R) or was not (blank) studied (1 byte); and (6) data source-DATALOG (D) or various files from Dr. Martin Alexander at Cornell University (H, M, G, A, or P) (1 byte). The file should be used with CASLST (in order to link the chemical name and formula) and XREF (in order to link the full reference citation).

7901 **(PB—89-851273/XAB) Nonreturnable packaging: the environmental debate. January 1982-November 1988 (Citations from Packaging Science and Technology Abstracts data base). Report for January 1982-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 108p. NTIS PC N01/MF N01.

Supersedes PB—86-861853.

This bibliography contains citations concerning the environmental and economic impacts of nonreturnable versus returnable food-packaging containers. Topics include the burdens on the environment due to nonreturnable beverage containers, economic considerations for the packaging industry, and government regulations imposed to reduce waste disposal. Various packaging containers are examined and include glass, aluminum, tinplate, cardboard, and plastics. Government legislation in the soft drink and beverage industries, dairy packaged products, and paperboard packaging are discussed. (This updated bibliography contains 276 citations, 139 of which are new entries to the previous edition.)

## 2904 Natural Resources

*REFER ALSO TO CITATION(S) 7365, 7877, 7878, 7879, 7901, 7932, 8039, 9402*

7902 **(EC/FO—Fs23-121/1987F) Canadian Arctic marine conservation strategy: discussion paper.** (Environment Canada, Ottawa, Ontario. Fisheries and Oceans). 1987. 17p. (In French). (MICROLOG—88-02215). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document presents an outline of Canada's Arctic Marine Conservation Strategy (AMCS) and its implementation. The AMCS is to serve as a step in ensuring sustained use of renewable resources and a careful balancing of industrial activities such as hydrocarbon development, community developments, and the pursuits of both hunting and fishing. The AMCS provides an overall framework within which Arctic marine resources should be managed. It provides for conservation and management of Arctic marine ecosystems, both to preserve the quality of the marine environment and to conserve the renewable resources which are an integral component of it. The AMCS and its implementation will be guided by the principles of Canadian sovereignty, benefit to society, maintenance of ecology and genetic diversity, use of an ecosystems approach and integrated management of renewable and nonrenewable resource activities, sustainable resource utilization, and recognition that the Inuit have particular rights and responsibilities. The Strategy will promote development of knowledge and understanding of marine systems and resource use, and will be built through consensus and mutual understanding with the user community. Implementation of AMCS will use existing institutions and processes wherever possible, through a series of action plans which will be developed from the strategies outlined in this document. These strategies include scientific research programs, shared management processes,

integrated conservation and management planning, and a system of marine protected areas in the Arctic.

7903 **(ME—8701) Mines and Minerals Branch report of activities, 1986.** Bates, J.L. (ed.); MacDonald, D.R. (Department of Mines and Energy, Nova Scotia (Canada)). 1987. 256p. (MICROLOG—88-01249). Nova Scotia Dept. of Mines and Energy, Joseph Howe Bldg., PO Box 1087, Halifax, N.S., Canada B3J 2X1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document contains a series of reports detailing the activities of the government department responsible for research, development, and policy regarding Nova Scotia's mineral resources. Within the Energy Resources Division, summaries are presented of petroleum industry exploration and resource assessment, both in onshore and offshore areas; and projects relating to coal and oil shale exploration and development. Other project reports are presented for the Mineral Development Division, which is concerned with such resources as industrial minerals, aggregate, stone, and metals, and the Mineral Resources Division, concerned with geology and exploration. This document also contains abstracts and excerpts from papers relevant to Nova Scotia mineral resources. Many of the projects described in this document were developed in cooperation with Energy, Mines and Resources Canada under an agreement designed to optimize, promote and encourage the orderly exploration for and development of the province's mineral resources, and are summarized in this document in order that preliminary results are made available as soon as possible.

7904 (NHR—1988, pp 431-438) **Pacific to Arctic transfer of water and biota. The McGregor diversion project in British Columbia, Canada.** Seagel, G.C. (Sutek Services Ltd., North Vancouver, B.C.). [1988]. Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

In 1976 the British Columbia Hydro and Power Authority (BC Hydro) initiated a program of studies to determine the environmental effects of a proposal to divert the waters of the McGregor River, a tributary of the Fraser River (Pacific drainage), into the Parsnip River, a tributary of the Peace River (Arctic drainage). The proposal would have required a 140 m high dam on the McGregor River which would have created a 23,600 hectare reservoir and overflowed the Arctic-Pacific divide. However, in 1987, as a result of the findings of the environmental studies, BC Hydro suspended consideration of this proposal. Specifically, the suspension was a result of findings that indicated that the development could introduce potentially harmful fish parasites into the Arctic drainage. This paper outlines the program of environmental studies undertaken for this proposed development. Particular attention is given to the extensive study of the transfer of fish and associated parasites and viruses. There was little in the literature to aid in the planning of such a study and the findings can be of value to others who may have to deal with the question of faunal transfer involving parasites, bacteria, viruses and fish.

7905 (NHR—1988, pp 367-384) **Effects of flow curtailment of the Eastmain-Opinaca and Caniapiscau Rivers downstream from the diversion facilities.** Messier, D.; Roy, D. (Societe d'energie de la Baie James, Montreal, Que.). [1988]. (In French). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

The creation of the La Grande River hydroelectric complex has necessitated the diversion of the upper basins of the Eastmain and Opinaca Rivers, south of the La Grande, and of the Caniapiscau, to the east. These three rivers originate in the Canadian Shield but their residual courses cut through either the fine sediments of the Tyrrell Sea (Eastmain and Opinaca) or, above all, fluvioglacial deposits (Caniapiscau and Koksoak). Downstream from the diversions, the additions brought by the Eastmain and Opinaca Rivers to the more mineralized waters, deriving from only one residual basin, besides the increase in contact time caused by the weak flow, have provoked a rise in turbidity, pH and the level of most nutrients and major ions. Nevertheless, on the Caniapiscau, the water quality of the residual course remains practically unchanged. The principal perceived ecological impacts come from the reduction in water volume, a greater stability and modifications in the water quality: increase in the zooplanktonic density and fish yields, adaptation of certain species to modifications in water quality. The response of the estuary environments is seen in the displacement of mixing and sedimentation zones upstream, and the organisms living in these environments have simply followed these displacements. 19 refs., 6 figs., 5 tabs.

7906 (NHR—1988, pp 337-352) **Water chemistry changes following diversion, impoundment and hydroelectric development in northern Manitoba.** Playle, R.C.; Williamson, D.A.; Duncan, D.A. (McMaster Univ. Hamilton, Ont.; Manitoba Dept. of Environment & Workplace Safety & Health, Winnipeg, Man.). [1988]. Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

Water chemistry changes have been identified in northern Manitoba's aquatic environments affected by interbasin tranfer of water and impoundment of rivers. The Churchill River diversion (CRD) and Lake Winnipeg regulation (LWE) were designed to enhance hydroelectric potential of the Nelson River and became operational in mid-1976. Statistical analyses of water chemistry data collected before and after mid-1976 from 10 sites along the Churchill, Burntwood and Nelson rivers indicated significant changes in a number of parameters. Conductivity decreased at all sites along the CRD route and increased at only one of four sites affected by LWR. Alkalinity decreased at four of five sites along the CRD route and was unchanged at the four upper Nelson River sites. Phosphorus concentrations increased at all sites affected by CRD exept at Split Lake, where concentrations were unchanged. Turbididy and nitrogen concentrations tended to increase and decrease, respectively, throughtout the region. Total inorganic carbon (TIC) decreased at three of the five sites along the CRD but increased at three of four sites affected by LWR. Split Lake, impacted by both CRD and LWR, exhibited no change in TIC concentrations. Significant relationships were indicated between certain water quality parameters and flow; some relationships which existed prior to mid-1976 have altered or ceased to exist since that time. Major hydroelectric projects like CRD and LWR require extensive monitoring and analysis if potential environmental changes are to be predicted accurately. 16 refs., 2 figs., 2 tabs.

7907 (NHR—1988, pp 279-293) **Impact of interbasin transfers on Lake Diefenbaker operation.** Banga, A.B.; Kallenbach, B.; Light, E.; Euteneier, D. (Saskatchewan Water Corp.). [1988]. Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

The Saskatchewan River system comprises the single most reliable water source in southern Saskatchewan. A major step in managing this vital resource was the construction of Gardiner Dam and the creation of Lake Diefenbaker during the 1960s. This reservoir serves a number of purposes including municipal, domestic, industrial, power generation, irrigation, recreation, flood control, water fowl projects, maintenance of minimum flows and withdraw-

al location for interbasin diversion. The creation of Lake Diefenbaker sparked the imagination of the public and water managers alike. Various proposals have been made to divert water from Lake Diefenbaker to water-short areas outside the South Saskatchewan River basin. This paper analyzes the impact some of these interbasin tranfer proposals would have on the operation of Lake Diegenbaker in terms of reservoir levels and flows downstream of Gardiner Dam. 7 refs., 11 figs., 3 tabs.

7908 (NHR—1988, pp 261-278) **Effects of flow diversion on the runoff regimes of northern Ontario rivers.** Woo, M.-K.; Waylen, R. (McMaster Univ., Hamilton, Ont.; Univ. of Florida, Gainesville, USA). [1988]. Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

Three river systems in northern Ontario have been regulated for interbasin transfer of water. The low divides between drainage basins in this region facilitate such transfer, while the abundance of lakes provide natural reservoirs for water storage. The three diverted rivers are located at the headwaters of Albany River, and have been diverted for such uses as hydroelectric power generation. The flow regimes of the exporting and importing rivers were compared to the natural flow patterns of their neighboring rivers. Diversion alters the annual flows and redistributes the monthly discharges. The long-term probability distributions of annual runoff, annual floods and annual low flows are also seriously affected. The Albany-English River systems are particularly interesting because they offer streamflow records for the periods before and after interbasin water transfer, making it possible to analyse the changes in their flow characteristics through time. It is seen that rivers which export water invariably undergo losses of flow, and the statistical distribution of their annual flows shows a high probability of zero or very low flows. Peak runoff for these rivers shows greater yearly variability because very high floods are permitted to pass but lower floods may be released to the importing channels. While the long term mean flows for importing basins are increased, their coefficients of variation are kept at around 25%. This is to maintain a steadier year-to-year water supply level. One other consequence is that the range of annual floods is also reduced; annual low flows, however, are more variable, with coefficients of variation exceeding 100%. 8 refs., 9 figs., 1 tab.

7909 (NHR—1988, pp 169-183) **Impacts of the transfer of water from the Eastman-Opinaca and Caniapiscau Rivers into the La Grande River (Quebec).** Roy, D.; Messier, D. (Society energie de la Baie James, Montreal, Que.). [1988]. (In French). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

The flow of the La Grande River in Quebec has practically doubled as a result of the diversion of the waters of the Eastmain and Caniapiscau Rivers for hydroelectric power development. Hydroelectric production has also been optimized by blocking minor tributaries of Fregate and Vincelotte Lakes. The rivers where the flow has been thus increased flow through regions of low erodability, except in the La Grande where marine clay and silty sands are found along its course. The volumes of suspended materials are more important in the latter due to the size of the water flow, the sensitivity of the riverbank materials and the variations in water level. The high stability of water quality depends on the common origin of the waters of the three rivers and on the aeration which occurs at the reservoir outlets. The planktonic organisms have reacted very little to the increase in flow. The La Grande is already hosting fish species found in the Eastmain and Caniapiscau, with the exception of Atlantic salmon, which is felt to be a a welcome introduction. The increases in mercury observed along the course of these rivers is due to the entrainment downstream of the water and the organisms contaminated in the reservoirs. 11 refs., 7 figs., 3 tabs.

7910 (NHR—1988, pp 153-168) **River diversions in northern Quebec: learning from the La Grand complex.** Penn, A.F. [1988]. Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN. (CONF-8711266—; MICROLOG—88-03679).

From Symposium on interbasin transfer of water: impacts and research needs for Canada; Saskatoon, Canada (9 Nov 1987).

The La Grande hydroelectric complex in Northwestern Quebec accounts for ca 40% of inter-basin transfer in Canada; planned development of rivers north and south of La Grand may increase tranfers in this region by 50% in the next 20-30 years. Little government or university-based research has been directed at the impacts of these diversions, but insights derived from monitoring by La Societe d'Energie de la Baie James now permit re-evaluation of initial environmental issues, and suggest directions for future research and monitoring. Construction of this poject will span 30 years (1971-ca 2000). Public debate in the early 1970s about the James Bay project (including hearings for an injunction) preceded definition of the eventual diversion routes. Major design changes followed in 1978, 1979 and 1986, of which the ecologically most significant may be the adoption of a 60% load factor (rather than 80%). Four more power plants will be built in the next 12 years. Both the timer-scale of impact assessment and ecological monitoring as applied to inter-basin transfers. Environmental concerns have also evolved with time. Flow reduction at the Eastmain and Caniapiscau estuaries, and the magnitude of flooding, drew attention at the outset. The focus now is on the transport of mercury and its uptake by fish, and the effects of flow augmentation in winter. An extra 30 km/sup 3/ of freshwater under shelf ice may affect eel-grass ecosystems used by migratory waterfowl, and changed flow conditions may radically affect anadromous stocks of whitefish and trout. The banks of the lower La Grand River are also attracting attention; high winter flows and daily water level changes are exposing marine sediments and triggering widespread instability. 16 refs.

7911 **(PB—89-101992/XAB) Economic study of the potential for water markets in Idaho. Report for 1 May 1985-30 April 1987.** Whittlesey, N.; Hamilton, J.; Halverson, P. (Washington State Univ., Pullman (USA). Dept. of Agricultural Economics). Dec 1986. 149p. NTIS, PC A07/MF A01.

This study investigated the economic potential for water markets that would exchange water from irrigated agricultural to hydropower production in southern Idaho. Two kinds of water market were considered. The first involved the marketing of stored water that is now owned by agricultural interests but is seldom used for irrigation. The second was an option lease program that would depend on water currently used for irrigation. A market for stored water is currently working but could be modified to increase the market value of the water. The value that could be created by selling stored water for hydropower far exceeds its current value in storage or for agricultural uses. The program analyzed would reduce average agricultural income about $2.50 per acre while the value of hydropower created would be about ten times this amount.

7912 **(PB—89-102271/XAB) Potentially critical materials. Open File report.** Foster, R.J. (Bureau of Mines, Washington, DC (USA)). Mar 1988. 73p. (BM-OFR—28-88). NTIS, PC A04/MF A01.

In the Bureau of Mines report a selection process has identified 14 nonstockpiled materials (cesium, gallium, hafnium, indium, osmium, rhenium, rhodium, rubidium, ruthenium, scandium, selenium, tellurium, thallium, and zirconium) that are linked to the continuing evolution of high-technology fields such as electronics, catalysis, and energy, and that have limiting factors associated with domestic availability. A qualitative assessment of the potential criticality of these materials was made through a consideration of end uses, demand trends and forecasts, production, mineral reserves, by-

product status, alternative supply sources, substitution and conservation options, and recyclability.

## 2905 Research, Development, Demonstration, And Commercialization

*REFER ALSO TO CITATION(S) 7195, 7386, 7387, 7686, 7903, 7925, 7937, 7938, 7949, 7959, 7960, 7961, 8039, 8056, 8069, 8105, 9360, 9361*

7913 **(DOE/NV/10617—T1) Los Alamos Operations: Quarterly progress report, August--October 1988.** (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). Dec 1988. Contract AC08-88NV10617. 78p. (LAO—312). NTIS, PC A05/MF A01 - OSTI. Order Number DE89004159/JAW.

LAO has two major areas of activity. The first includes the design fabrication, testing, and fielding of data acquisition systems used for diagnostics in underground nuclear testing. The second includes providing experimental support, engaging in data acquisition, and performing analysis of experiments involving microwave propagation in air. Analysis is also performed on weapons effects data acquired during the US Nuclear Atmospheric Test Program. The current emphasis is on digital concepts and special imaging systems, including state-of-the-art fiber-optic light guide and streak-camera technology. This progress report highlights LAO's many areas of technical involvement. Projects in progress or done at LAO under other funding sources, i.e., R&D, cash orders, Economy Act Orders, etc., as well as miscellaneous programmatic tasks, are included in Sections V and VI. They are included for completeness and to illustrate the varied but complementary nature of the work done by LAO personnel. We have attempted to make these quarterly progress reports continuous but with a stand-alone format. Projects not completed in one quarter are automatically reported the following quarter. Continuing projects are covered even though no activity may have occurred during the quarter. In all cases, we have attempted to note the completion or transition with no change in format, but with sufficient detail to enable the technical reader to evaluate the status of each project. In some cases more detailed documents are referenced in the text of this report. 15 figs., 7 tabs.

7914 **(NISTIR—88-3886) Research for electric energy systems: An annual report.** Van Brunt, R.J. (ed.). (National Inst. of Standards and Technology, Gaithersburg, MD (USA). Electrosystems Div.). Nov 1988. 79p. OSTI. Order Number TI89004365/JAW.

This report summarizes the technical accomplishments during fiscal year 1987 from a US Department of energy sponsored program at the National Bureau of Standards to provide technical support for DOE's research on electrical energy systems. Major activities associated with each of the four subtasks that constitute the program are highlighted. These include research on: (1) electric field and ion measurements; (2) fundamental physical and chemical processes in commonly used gaseous dielectrics like $SF_6$; (3) development of advanced methods for observing and catagorizing prebreakdown interfacial phenomena in liquid dielectrics; and (4) evaluation of advanced methods for characterizing transient measurements by use of step response and convolution integrals as they apply to free standing dividers. 78 refs., 38 figs., 6 tabs.

7915 **(PNL-SA—15568) Technology transfer: Case studies from the Pacific Northwest Laboratory.** Schmid, L.C. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003917/JAW.

Through the integration of advanced concepts and computers, scientists at the Pacific Northwest Laboratory (PNL) developed a method for measuring uranium concentrations in bioassays more quickly, easily and accurately than conventional analytical methods. The new technique, called kinetic phosphorimetry, was developed for the Department of Energy (DOE). It is ten times more accurate and reliable than current methods and can be done more quickly and with smaller samples; thus the cost of analysis and probability of error in sampling and analysis are greatly reduced.

7916 **(UJV—8351-V) Report on advances '87.** Havelka, S. (ed.). (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Feb 1988. 66p. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704895/JAW.

The most important scientific, technical and partly also economic results attained in 1987 by UJV Rez are summed up. Research and development work in nuclear power is oriented to nuclear safety, reactor physics, reactor materials, reactor technology, chemistry of the fuel cycle and standardization. In the field of the use of ionizing radiation the problems resolved included radiation technologies, radiopharmaceuticals, neutron activation analysis and neutron radiography. Some of the works were also oriented to radiation safety. In the field of production and services the study was oriented to the production of radiopharmaceuticals, semiconductor ionizing radiation detectors, services of the Central Control Laboratory, irradiation services, computer and information services. The social program of the Institute was oriented to upgrading personnel, the housing programme, catering, working environment and recreation. The organization structure of the Institute is given. (J.B.). 36 figs., 11 tabs., 101 refs., 10 colour illustrations in Supplement.

## 2906 Nuclear Energy

*REFER ALSO TO CITATION(S) 7430, 7432, 7433, 7456, 7822, 7937, 9134, 9505, 10486*

7917 **(AD-A—197380/9/XAB) Reenlistment behavior of nuclear-trained enlisted men. Master's thesis.** Cook, R.W. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 101p. NTIS, PC A06/MF A01.

This thesis investigates reenlistment behavior of a particular occupational sector of the U.S. Navy. The data set consists of enlisted members with nuclear NECs and 4 to 9 years of service during the 1977-1987 time frame. Specific pay and employment data from the civilian nuclear industry is used for comparison to military pay. Two econometric-modeling techniques are employed: logit analysis for individual level data, and time-series cross-sectional analysis for pooled data. The effect on reenlistment probability of changes in relative military and civilian salaries is determined. The results demonstrate the importance of pay to the reenlistment decisions of these men, but indicate that the supply elasticity is relatively low. It is argued that this low responsiveness of retention to pay changes is due not only to the arduous conditions of the work environment, but to the fact that military-to-civilian pay ratios were uniformly low during the period of observation. Previous research concerning the relationship of retention to pay has aggregated occupational categories and found higher elasticities. This paper shows that retention behavior can be better understood using information about compensation in disaggregated military occupational sectors and specific civilian alternatives.

7918 **(AD-A—197878/2/XAB) Environmental radiation monitoring during visits of nuclear-powered warships to Australian ports.** (Department of Defence, Canberra (Australia)). May 1988. 14p. NTIS, PC A03/MF A01.

The Commonwealth Government has determined conditions to be met when nuclear-powered warships visit Australian ports. These conditions include a requirement that appropriate State/Territory and Commonwealth authorities provide a radiation-monitoring program to determine whether any radioactivity has been discharged or accidentally released from a nuclear-powered warship in port; to determine actual or potential levels of any consequent exposure to radiation of members of the public; and to provide this information within a time scale that allows remedial action to be taken. Part 1 of this document sets out the requirements of a radiation-monitoring program capable of meeting these objectives. The fundamental arrangements and procedures for implementing the requirements are presented at Part 2 and provide a basis for the development of fully detailed, port-specific, radiation monitoring programs.

7919 **(AD-A—197981/4/XAB) PACOM net assessment: Pakistani and Indian nuclear perceptions. Volume 2. Appendix. Sanitized. Technical report.** Yim, S. (Analytical Assessments Corp., Marina Del Rey, CA (USA)). 31 Aug 1983. 9p. (AAC-TR—18161/83-VOL-2-SAN). NTIS, PC A02/MF A01.

The conclusions of a number of the commentators in the documents from which this information was derived are that the Pakistani and Indian nuclear weapons programs are stimulated by their rivalry and fueled by the weapons aid and aid to nuclear-power programs supplied to each country by the U.S. and the USSR.

7920 **(IFE/KR/E—88/004) Nuclear power - status and development 1987/88.** Lingjaerde, R. (Institute for Energy Technology, Kjeller (Norway)). Sep 1988. 20p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755663/JAW.

A review of the present global position of nuclear power is given. Topics as resources, production and demand of uranium, the development in reactor technology and the expansion of nuclear power in USSR are briefly dealt with.

7921 **(INIS-mf—11850) For a socially compatible power supply system.** Langmann, H.J. (Bundesverband der Deutschen Industrie e.V., Koeln (Germany, F.R.)). Apr 1987. 13p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755957/JAW.

BDI-Drucksache.; no. 203.

The definition of social compatibility is an outcome of continuous analysis and assessment of impact on the society, also covering probable effects in future. In a democracy, this leads to political decisions of the government based on consideration of all relevant criteria. This is why in modern, highly industrialized societies with their complex structures, basis-democracy procedures which involve strong emotionalisation have been replaced by a system of decision-making powers given to authorities for a defined period of time. Applying these principles to the power industry, the author's analysis of the role of nuclear power in the electricity market, and later on in the heat market, is said to remain significant for many decades to come, at least for a time horizon not to be defined as yet. Nuclear power generation will increase. Should there be realistic chances in the power market one day for alternative energy sources, the process of nuclear power substitution will take many years, and will proceed in a way justifiable by responsible energy policy. (orig./HSCH).

7922 **(INIS-XN—131) Nuclear Energy Act.** (International Atomic Energy Agency, Vienna (Austria)). 11 Dec 1987. 57p. NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE88704922/JAW.

Translated from Finnish.

The Nuclear Energy Act (No. 990/1987) entered into force on 1st March 1988, repealing the Atomic Energy Act of 25th October 1957 (No. 356/1957) and Decree of 14th February 1958 (No. 75/1958). The 1987 Act is comprehensive, covering uranium mining operations, nuclear facilities, all uses of nuclear material, including exports and imports, nuclear waste management etc., as well as non-proliferation issues.

## 2907 Transport And Storage

*REFER ALSO TO CITATION(S) 7940*

## 2908 Waste Heat Utilization

*REFER ALSO TO CITATION(S) 7875, 8046, 8051, 8052, 8053*

7923 **(PB—89-106645/XAB) Summary of the workshop on nonutility power generation in India: September 28, 1987-New Delhi and October 1, 1987-ahmedabad.** (Hagler, Bailly and Co., Washington, DC (USA)). Feb 1988. 54p. (HBC/REF—4481). NTIS, PC A04/MF A01.

In 1986, a study was conducted to explore the prospects for non-utility power generation (NUPG) in the Indian States of Gujurat and Maharashtra, with a focus on the private sector and indicated that NUPG from large domestic fossil-fuel plants, industrial and commercial co-generation systems, and renewable energy sources presents a viable option for improving power supply in the two States. Two follow-up workshops were held in 1987. Each included a presentation of study findings, panel discussions on policy and financing issues, a question and answer session, and a summary session; the New Delhi workshop also included a technical session. The report on the two workshops details views expressed by participants on constraints to NUPG, together with recommendations to overcome them. The main issues discussed were the adequacy of government policy regarding both NUPG and captive generation (electricity generation by a non-utility entity for its own use, rather than sale to the grid) and the difficulty of financing power projects. The problems of availability, quality, and price of fuels and equipment and interconnection with the grid were also discussed.

## 2910 Conservation

*REFER ALSO TO CITATION(S) 7937, 7938, 7958, 7979, 7982, 7998, 8019, 8021, 8022, 8055, 8078*

7924 **(AD-A—199078/7/XAB) Making shared energy savings work. Final report.** Neve, T.L.; Salthouse, R.W. (Logistics Management Inst., Bethesda, MD (USA)). Jul 1988. 73p. (LMI-AL—703R1). NTIS, PC A04/MF A01.

Shared energy savings (SES) is a low-investment, low-risk-contracting procedure that can significantly increase energy efficiency at DoD installations. By decreasing installations' energy use by only 10%, SES can save some $300 million a year. Under SES, contractors finance and implement efficiency measures and share the resulting dollar savings with DoD. Notwithstanding its low risk and low investment, however, SES faces several obstacles: Establishing prior energy use - 'baselines' - in DoD buildings in order to measure savings is difficult since (1) very few buildings are individually metered, and (2) most energy-service companies have no confidence in computer-simulated baselines. Installation managers are unwilling to implement SES without the guarantee they will receive a portion of DoD's share of savings. Uncertainties regarding the applicability of law and regulation to SES contracting are slowing implementation. The Military Departments have not agreed upon the appropriate economic criteria to be used in the competitive award of SES contracts.

7925 **(DOE/CE—0241) Comprehensive program and plan for federal energy education, extension and information activities: Annual revisions: The twelfth report to Congress.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of State and Local Assistance Programs). Nov 1988. 89p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004295/JAW.

The document which follows, the twelfth presented to Congress, responds to two legislative requirements. It is the annual revision to the Comprehensive Program and Plan for Federal Energy Education, Extension, and Information Activities pursuant to Section 508(c) of the National Energy Extension Service Act, Public L. 95-39, 42 U.S.C. 7007(c). It is also the report required under Section 404(2) of the Energy Security Act, Public L. 96-294, 42 U.S.C. 7373. The report is being submitted to Congress as an addendum to the Department of Energy's budget submission. This revision, like its predecessors, illuminates the coordinating activities between and among the participating federal departments and agencies. The report aggregates in this compendium format, current federal energy education, extension, and information activities. Programs cover a range of energy applications, and address many different and mutually exclusive audiences through a range of delivery mechanisms, including volunteer efforts, research and development initiatives, and intensively managed efforts aimed at specific audiences. This report reflects the coordination efforts of federal agencies, states, local communities and private groups in carrying out these energy programs. As each program makes clear in its summary, the successes and accomplishments of the included programs are periodically evaluated to determine their continuing need and effectiveness. The results of these evaluations are reflected by the cur-

rent programs and the emphasis these programs have placed on aspects of energy conservation and use. 2 figs.

7926 **(DOE/CH/10093—29) Programs in energy conservation.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1988. Contract AC02-83CH10093. 22p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89000801/JAW.

This document provides a summary of the Energy Conservation Program of the US Department of Energy (DOE). The activities performed by the program are those that contribute to satisfying a national need. Initiatives are taken only after such needs have been identified and assessed by representative members of the entire energy conservation community. In general, the projects that successfully emerge from this process and are pursued by the program are those that, because of high risk, will not be undertaken by the private sector acting alone. However, the success of the program relies on the active participation and contribution of the private sector--industry, universities, and other research institutions--complemented by the significant resources available within our national laboratories. We hope that this document will not only provide a basic understanding of our program but that it will also stimulate further inquiries and suggestions concerning the program and its possible future directions.

7927 **(DOE/CH/10093—30) Programs in energy conservation: Energy Conversion and Utilization Technologies.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1988. Contract AC02-83CH10093. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89000802/JAW.

The Energy Conversion and Utilization Technologies (ECUT) Program was established as an interdisciplinary applied research and exploratory development program as a result of a 1979 Department of Energy (DOE) Technology Base Assessment. The assessment identified a deficiency in the level of federal support for technology base research needed to sustain long-term efficiency improvements in the conversion and use of energy. The ECUT Program is administered by the Office of Energy Utilization Research, which is in DOE's Office of the Deputy Assistant Secretary for Conservation. ECUT focuses on five interdisciplinary research areas that are generic to energy conservation: combustion, materials, thermal sciences, biocatalysis, and tribology. By challenging conventional wisdom in combination with careful planning, sound decisions, and well-spent dollars, ECUT researchers are pioneering exciting new technologies. In this brochure, we highlight the program's unique approach and some of its major accomplishments.

7928 **Household energy conservation: a review of the federal residential conservation service.** Hirst, E. (Oak Ridge National Lab., TN (USA)). *Public Administration Review;* **44**: No. 5, 421-430(Sep 1984). Contract AC05-84OR21400.

Most electric and gas utilities provide free or low-cost energy audits to their residential customers, usually as part of the federal Residential Conservations Service (RCS). RCS programs in the few states where competent evaluations were done show incremental energy savings for participants of approximately 3.5 percent. Assessing the economic worth of RCS programs is particularly difficult (and very site-specific) because of factors such as future fuel prices, differences between marginal and average fuel prices, discount rates, and differences in how programs are implemented. The meager evidence on RCS program cost-effectiveness suggests that the economic benefits are generally small. 28 references, 2 figures, 3 tables.

## 2920 Supply, Demand, And Forecasting

*REFER ALSO TO CITATION(S) 7325, 7328, 7707, 7870, 7872, 7877, 7878, 7879, 7942, 8038*

7929 (CERI—1988, pp 11) **The status and perspective of energy in China to 2005.** Qi. Z.F. (Energy Research Inst. Beijing, China). 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

This paper describes China's energy resources, energy production and consumption, energy demand and supply forecasts to 2005, and exploration and development in the offshore oil sector. The main factors influencing energy supply are energy investment, technical levels of energy development and utilization, transportation and environment, and government policies. Oil and gas industries are expected to have difficulty in developing rapidly if oil prices stay low. Supply/demand forecasts show that primary energy demand in 2000 may have a considerable gap, especially for high quality energy such as electric power. The energy demand forecast for 2005 assumes a quadrupling in industrial and agricultural output; the results of the forecast show energy supply coming mainly from coal (about two thirds) and oil (one fifth) with gas and hydroelectricity making up most of the remainder. 4 tabs.

7930 **(EMR—1984) Energy alternatives for Prince Edward Island. Executive summary.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1984. 24p. (CE—02114). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The general objective of this study is to determine the economic costs of alternative energy supply options, including conservation, for Prince Edward Island. The analysis is undertaken from a socioeconomic perspective, calculating a long-term real supply price per unit of energy for each type of energy considered for each end use. All relevant costs are discounted at a social discount rate over the life of the supply option. These costs are then summed to yield a present value cost, which is then divided by the discounted energy sum to yield a supply price in $/GJ. Costs of production are evaluated, insofar as possible, as the costs imposed on society. Some key conclusions are as follows. Energy plays a relatively smaller role on the Island economy than in Canada as a whole. The role of energy is particularly small in the Island's industrial sector. Energy costs are higher on the Island than in the rest of Canada, particularly electricity costs. Overall per capita energy consumption is projected to increase by ca 16% by the year 2000, and the residential and commercial sectors are expected to continue to be the dominant energy users. Regarding the most cost effective energy options for the Island, conservation is the most economic investment for residential and space heating. Wood is the most cost-effective option for residential and commercial/institutional space heating. Oil is the most economic alternative for residential water heating and industrial process heat. Natural gas and propane systems do not appear to be economically viable. Electricity and solar options are not economically preferred for any of the end uses examined. 1 fig., 8 tabs.

7931 **(ESC-WR—88-22) Cost optimization of the future Netherlands energy system under environmental constraints. Coping with less natural gas.** Tiemersma, D.N. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Sep 1988. 19p. Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Energy Study Centre (ESC) of the Netherlands Energy Research Foundation (ECN) recently has completed an extensive study on the possibilities of new energy technologies up till the year 2020. The possibilities of new technologies for the Netherlands, market shares in various sectors, has been investigated by means of the dynamic linear programming computer code MARKAL which allocates markets during an economical minimalization of the costs of the complete energy system, simultaneously for the whole period till 2020. Various constraints and boundary conditions have been applied to the energy system: availabilities and costs of energy carriers, several levels of environmental constraints, and different developments in energy demand. Results are presented for two scenarios, which differ in several respects, among which the availability of domestic natural gas and emission constraints for NO/sub x/ and SO/sub 2/. The Dutch energy system appears to be rather stable, with only minor influences from changes in boundary conditions and constraints. This can be attributed to the availability of domestic natural gas which allows for a smooth transition into a more coal based energy system. Environmental constraints do not lead to substitution of gas for coal. Instead emissions are mainly reduced by application of abatement techniques as well as shifts in the use of energy conversion technol-

ogies. Very low emission levels can be reached, even if the availability of natural gas is limited and nuclear energy is abandoned. In that case coal gasification and more efficient use of natural gas are the options to be applied on a large scale. 8 figs., 3 refs., 1 tab.

7932 **(LA—11205-MS) An energy atlas of five Central American countries.** Trocki, L.; Newman, C.K.; Gurule, F.; Aragon, P.C.; Peck, C. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 125p. (EN;SP). NTIS, PC A06/MF A01 - OSTI. Order Number TI89004548/JAW.

In a series of maps and figures, this atlas summarizes what is known about the energy resources and how these resources and oil imports supply the energy needs of five Central American countries: Guatemala, El Salvador, Honduras, Costa Rica, and Panama. The main exploited energy resources are firewood, hydroelectric energy, bagasse from sugar cane residues, and geothermal energy. Limited oil exploration in the region has uncovered modest oil resources only in Guatemala. Peat and small coal deposits are also known to exist but are not presently being exploited. After the description of energy resources, this atlas describes energy supply and demand patterns in each country. It concludes with a description of socioeconomic data that strongly affect energy demand. 4 refs.

## 2930 Policy, Legislation, And Regulation

*REFER ALSO TO CITATION(S) 7424, 7425, 7430, 7432, 7433, 7944, 8056*

7933 (CERI—1988, pp 7) **Energy Options - energy and Canadians into the 21st century.** Reinsch, A.E. 1988. Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $100.00 CAN. (CONF-8809206—; CE—02029).

From 7. CERI international oil and gas conference; Calgary, Canada (18 Sep 1988).

This presentation gives the views of a representative of the Canadian Energy Research Institute on the conclusions and recommendations contained in the final report of the Energy Options advisory committee. Energy Options was a series of conferences and dialogues discussing the future choices for Canadian energy policy and energy sources/resources. Views of participants are summarized under the areas of energy and development, energy security, energy and the environment, energy and markets, energy and the fiscal system, energy efficiency, and energy and technology. It is concluded that Energy Options has provided a framework of principles for government energy policy within the context of a deregulated market environment. Important roles for energy policy include stable fiscal and developmental policies, proper mix of incentives and penalties to ensure minimum environmental impacts, and support of research, development and demonstration of energy technologies.

7934 **(CRIE-Y—87017) Economics of scale in Japanese electric utilities.** Nakanishi, Yasuo; Ito, Nariyasu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755736/JAW.

In order to get a foundamental information about policy implication of deregulation for electric utilities in Japan, scale economies on which regulations were authorized basically were measured in practice. Defining scale economies in terms of relative increase in output resulting from a proportional increase in cost, each 4 cases, i.e. aggregated firm level and generation level, were analyzed. As electric utilities in Japan are integrated with generation, transmission and distribution, it is important that what level we need to deregulate. The main results are the followings; scale economies is decreasing for both aggregated firm level and generation level, and for the former, it has existed in recent years, but for the latter, it has not existed by effects of fuel cost since several years. Similar tendencies of results were measured in both firm and generation level on disaggregate cases. However, there are some differences in each electric utilities because of demand density or structure of power system. And larger the scale of utilities, smaller scale economies in recent years. (2 figs, 13 tabs, 14 refs)

7935 **(DOE/CP—0013) Major energy issues before the 100th Congress.** (USDOE Assistant Secretary for Congressional, Intergovernmental and Public Affairs, Washington, DC. Office of Congressional Affairs). Dec 1988. 103p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004976/JAW.

This report reviews the major energy issues before Congress. For each issue the relevant legislation, a discussion, and a final disposition is given. (JF)

7936 **(DOE/MA—0333-3) United States Department of Energy small and small disadvantaged business subcontracting program report.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). Nov 1988. 116p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004338/JAW.

The United States Department of Energy Small and Small Disadvantaged Business Subcontracting Program Report is published quarterly. This report provides a list by product or service of contracts with subcontracting plans and summary data on DOE subcontracting commitments to small and small disadvantaged business firms. The data was extracted from the Procurement and Assistance Data System (PADS) and the Subcontracting Reporting System (SCORS). Contractors with contracts containing subcontracting plans must report to DOE at the end of each fiscal quarter using Standard Form 294 or DOE F 4200.4 for Management and Operating contracts. The data from these forms is stored in SCORS and has been used for the "Contractors with Subcontracting" portion of this report. The contractors are displayed alphabetically by name in two sections. Part B excludes Management and Operating contracts; Management and Operating contracts are presented in Part C. The principal place of performance, the contract number, the value of the prime contract, and the amount of subcontracting planned are shown for each contract. The socioeconomic goals and obligations are listed by both percentage and amount. The total actual subcontracting obligations for the quarter complete the picture. The percentage goals are based on the amount of subcontracting planned. The percentage of obligations, which represents achievement for the quarter, is based on the total subcontracting obligations. All reports contained in SCORS for that quarter are included; some data may pertain to contracts that do not contain a subcontracting plan, but report under certain circumstances.

7937 **(DOE/MA—0347) Report to Congress on the Small Business program: Fiscal year 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Small and Disadvantaged Business Utilization). 1988. 39p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004508/JAW.

The Department of Energy (DOE) is pleased to submit to the Congress its 1987 Small Business Program Report as required by Section 204, Public Law 95-238, "Department of Energy Act of 1978, Civilian Applications." This Report covers twenty-eight organizational components of the Department and details the extent to which small business concerns are participating in the DOE procurement process, as well as efforts taken throughout the agency to assure continued participation in the future. Defense Programs are not included in this Report as Section 204, Public Law 95-238 excludes military applications of nuclear energy.

7938 **(DOE/PE—0088) 1988 selected papers and presentations by DOE's Policy Integration Office staff.** (USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC. Office of Policy Integration). Dec 1988. 166p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004611/JAW.

This report contains papers on the following topics: Cost Effectiveness of Future Fuel Economy Improvements; Economic and Security Issues of Methanol Supply; Timing of Methanol Supply and Demand; US Policies and Technology Options; Alternative Fuels Market Development; The Cost of Making Methanol Available to a National Market; Method for Energy Policy Analysis; Transportation Energy to the Year 2000; Energy Conservation Potential; Least-Cost Utility Planning; Appropriate Comparisons of International Energy Data; The Role of Energy Costs in the CPI-

U; Trash to Energy, a Burning Issue; Methanol's Contribution to Energy Security in the USA; The Senegal River Basin Development Program; and The US Transportation Sector in Perspective.

7939 **(LA—11315-MS) Lessons of Chernobyl.** Ramberg, B. (Los Alamos National Lab., NM (USA)). Jul 1988. Contract W-7405-ENG-36. 11p. (CNSS/Papers—14). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004431/JAW.

Dr. Bennett Ramberg discusses the nuclear plant safety attitude leading to the Chernobyl accident, he reviews the accident and its immediate impact, and he then considers its long-term impact on the nuclear power-generating industry worldwide. This paper is based on a talk given by Dr. Ramberg on May 4, 1987, at the Center for National Security Studies of the Los Alamos National Laboratory. The presentation was followed by a question and answer session.

7940 **(NEB-SS—BT31-2/1989-111-14) National Energy Board, 1988-89 estimates. Part 3. Expenditure plan.** (National Energy Board, Ottawa, Ontario (Canada)). 1988. 65p. (In English and French). (MICROLOG—88-02493). National Energy Board, Regulatory Support Office, 473 Albert Street, Ottawa, Ont., Canada K1A 0E5; $3.00 OTHER COUNTRIES $3.60 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The National Energy Board of Canada has two main responsibilities: regulation of specific areas of the oil, gas and electrical industries in the public interest, and advising the government on energy resource development and use. Activities of the Board are primarily in regulating pipelines and energy exports. It also holds energy-related inquiries, carries out studies and prepares reports. This report describes the organization, functions, programs, and plans of the Board, with highlights of recent performance and a summary of financial and personnel requirements for the forthcoming fiscal year. 2 figs., 7 tabs.

## 2940 Fossil Fuels

*REFER ALSO TO CITATION(S) 7209, 7325, 7329, 7329, 7330, 7333, 7350, 7350, 7351, 7351, 7903, 7952, 8036*

7941 **(AMTU—87) Alberta Utilities annual report, 1985-86.** (Alberta Ministry of Transportation and Utilities, Edmonton (Canada)). [1987]. 42p. (MICROLOG—88-05062). Alberta Transportation and Utilities, Office of the Minister, 208 Legislature Building, Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report summarizes the year's activities of an Alberta government agency responsible for public utilities in that province. Its Gas Utilities Division is responsible for ensuring an economical and efficient supply of natural gas and related services to rural gas distributors, providing support services to rural gas distribution, and regulating aspects of rural gas utility design, construction and operation. Grants and loans are also provided to rural gas distributors and cooperatives. Within the Utilities, Communications and Planning Division, a number or rebate programs are being carried out which reduce energy expenses in various sectors, and a Natural Gas Price Protection Plan shelters Albertans from the effects of significant gas price increases. The Rural Electric Branch administers loans and manages grant programs to assist rural electrification. Other branches of the agency are involved in administration, communications policy, and non-energy-related utilities such as water and sewage. Financial statements and statistics are also included. 16 figs., 8 tabs.

7942 **(CONF-8811120—1) Oil sharing and policy coordination: The implications for developing countries.** Horwich, G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003931/JAW.

From Southern Economic Association conference; San Antonio, TX, USA (21 Nov 1988).

The major program of response to energy emergencies inherited from the 1970s is the International Energy Program (IEP) of the International Energy Agency (IEA). The central feature of the IEP is a system of oil sharing, to be triggered by oil supply cutoffs of 7% or more to individual member countries or the group as a whole. In assessing the effectiveness and desirability of the IEP, an empirical study of the contemporary world oil market indicates that it adjusts equally well in disrupted and normal circumstances. Less developed countries and other nonparticipants are thus likely to experience without delay the effects of oil supply disruptions as well as any effects, positive or negative, of sharing among IEA members. Assessment of the sharing program indicates that import quotas, which could be imposed by countries whose "supply rights" under the program require them to limit their consumption of oil, could, in the presence of even a small degree of oligopoly production, result in perverse increases in the world price of oil. Prices would be pushed in a downward direction, however, if sharing were to be only partially implemented, with members entitled to receive oil failing to exercise their rights. LDCs, along with all trading countries, would experience these price changes. It is doubtful that membership in the IEA, should it ever be offered, would confer net benefits on LDCs. Their demand elasticities are more likely to make them donors of oil than recipients in a disruption. The lack of accumulated oil stocks makes LDCs especially vulnerable to the need to impose domestic price ceilings and mandatory allocations on general petroleum use as part of the attempt to fulfill their sharing obligations. 18 refs., 2 tabs.

7943 **(DOE/FE—0101-3) Strategic petroleum reserve: Quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 15 Nov 1988. 9p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004006/JAW.

This November 15, 1988, Strategic Petroleum Reserve Quarterly Report describes activities related to the site development, oil acquisition, budget and cost of the Reserve during the period July 1, 1988 through September 30, 1988.

7944 **(ERCB—88-40) Alberta energy, 1987. Review of Alberta energy resource.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). [1988]. 58p. (MICROLOG—88-05071). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $25.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Energy developments within Alberta are reviewed and placed within the context of both Canadian and world trends and developments. The report opens with a history of the Alberta Energy Resources Conservation Board, which was founded in 1938 in order to encourage resource development, protect the public interest, and ensure resource conservation. A major original concern was the waste of gas flared from early oilfield developments, and starting from the regulation of the petroleum and natural gas industries the Board has expanded to include oil sands, coal, pipelines, hydroelectricity, and power generation and transmission. The report continues with a summary of Alberta's energy reserves, mainly oil and gas, examining how much of these reserves have been developed, produced and marketed, and how much is left for the future. Data are also presented on energy sales, investment, and employment in the energy sector. Alberta's energy end-use requirements are then presented; Canada continues to rely on Alberta for a major portion of its total energy production, and is expected to continue to do so in the future. However, the pattern of oil production will change, with conventional oil expected to decline, and synthetic crude and bitumen to increase. The report concludes with a summary of operations of the Energy Resources Conservation Board, including a discussion of environmental issues related to oil and gas production. 42 figs.

7945 **(NP—9770178) Energy supplies today and tomorrow. Interdepartmental day of the technical departments of Fachhochschule Osnabrueck, May 13, 1988.** (Fachhochschule Osnabrueck (Germany, F.R.)). 1988. 148p. (In German). NTIS (US Sales Only), PC A07. Order Number DE89770178/JAW.

Because of its great importance to society the subject of 'energy supplies' occupies a special place in public discussions. In this context the Fachhochschule Osnabrueck sees it as its task to offer information on the way in which the energy requirement is currently being met, as well as to depict some emerging future lines of development. This year's interdepartmental day of the technical departments was marked by a heavy emphasis in the lectures on current progress in the use of fossil fuels. The special concerns of the local area (e.g. in questions of environmental protection) are duly dealt with. In addition, the level of development in the use of the regenerative energy sources, sun and wind, is presented.

7946 **(ORNL/TM—10857) The aggregate production profile for US crude oil.** Christiansen, D.S.; Reister, D.B. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89001959/JAW.

We estimate the aggregate production profile for US crude oil for the period 1961 to 1985. Using data on reserves, we find that there is a significant lag between the time that reserves are added and the time production peaks. We attribute this long lag to a system of production controls that existed until about 1970. When we re- estimate over the period from 1970 to 1985, we find that there is a much shorter period between reserve additions and peak production. We consider an alternative approach based on drilling data that gives similar results for the entire sample period but different results for the subperiod 1970-1985. We discuss the factors that are responsible for the general shapes of the profiles we estimate. 14 refs., 22 figs., 4 tabs.

7947 **(P—300-88-003) Quarterly oil report: First quarter, 1988.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jun 1988. 45p. California Energy Commission, Publications Unit, 1516 Ninth Street, MS 13, Sacramento, CA 95814. Order Number TI89003825/JAW.

California's petroleum fuel trends paralleled those of the nation in the first quarter of 1988. Demand for most fuels was higher than year ago and previous quarter levels. The total volume of all petroleum products supplied increased 2 percent from the previous quarter and continued a four year trend of increasing demand for most fuels, particularly unleaded gasoline. From 1984 through 1986 electric consumption of low sulfur fuel oil (LSFO) gradually increased declining in 1987. However, LSFO consumption increased in the first quarter of 1988. 11 figs., 6 tabs.

## 2960 Electric Power

*REFER ALSO TO CITATION(S) 7573, 7707, 7718, 7911, 7934, 7941, 7944, 7976, 8009*

7948 **(AMTU—1987) Alberta Transportation and Utilities annual report, 1986/87.** (Alberta Ministry of Transportation and Utilities, Edmonton (Canada)). [1988]. 108p. (MICROLOG—88-04552). Alberta Transportation and Utilities, Office of the Minister, 208 Legislature Building, Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Alberta Transportation and Utilities contains an Engineering Division responsible for functional support service to the roadway and airport programs, a Regional Transportation Division responsible for the major highway and airport construction programs, an Urban Transportation and Planning Division providing financial and planning assistance to major urban areas and municipal authorities, a Transportation Safety Branch responsible for reducing the number of motor vehicle accidents, the Alberta Motor Transport Board which provides Alberta's liaison with other governments, the Alberta Motor Transport Branch which provides operational and administrative support to the aforementioned Board, the Municipal Utilities Division providing support services for the development of water supply and sewage treatment facilities, and branches that deal with administration and public information. In addition, it contains the following divisions of energy interest: the Utilities, Planning and Rural Electric Division, responsible for providing analysis and advice to assist the government in decisions on utility policies, for administering rural electrification programs and services, and for delivering heatng fuel rebate programs; and the Gas Utilities Division, responsible for implementing policies and programs for natural gas utilities and for the administration of grants to rural gas distributors. This report summarizes the year's activities of this government body and includes financial and statistical information.

7949 **(EPRI-EM—6109) End-use power quality R&D planning: Proceedings.** Chester, T.; Koeturius, C. (Electric Power Research Inst., Palo Alto, CA (USA); Power Electronics Applications Center, Knoxville, TN (USA); TEM Associates, Inc., Emeryville, CA (USA)). Nov 1988. 72p. (CONF-8706358—Summ.; CONF-8708297—Summ.). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89003832/JAW.

From Conference on end-use power quality R and D planning; Williamsburg, VA, USA (1 Jun 1987).

Conf No. 8708297 should also be in Field No. 449.

This report summarizes EPRI's efforts to formulate an end-use power quality R&D and technology transfer program. To identify and prioritize possible research initiatives, EPRI and the Power Electronics Applications Center (PEAC) organized two conferences where technical experts could discuss issues and opportunities in end-use power quality. The first End-Use Power Quality R&D Planning Session, held in Williamsburg, Virginia, brought together experts in end-use power quality from industries, electric utilities, academia, EPRI, and PEAC. The purposes of the session were to identify and discuss the major R&D needs related to end-use power quality, including basic research, technology development, and equipment applications and testing. At the second meeting, in Palo Alto, electric utility representatives reviewed, modified, and prioritized the R&D menu developed at Williamsburg.

7950 **(ISI-A—1-87) Influence of energy policy measures and tariff alterations on the future electricity consumption of individual sectors and cooperation in energy economy.** Brand, M.; Gruber, E.; Jochem, E. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). 1987. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756112/JAW.

This working paper came about within the framework of a joint project with Prognos AG in Basel for the Minister for Economy, Trade and Technology in the State of North-Rhine Westphalia which is entitled: 'Energy conservation and production without the use of nuclear energy: Feasibility and effects in terms of energy, ecology and economy.' The problems of energy conservation are systemtically drawn up for the individual sectors of energy consumption. A package of measures for a solution to these problems is proposed for each sector and is evaluated in its overall effect on future energy consumption.

7951 **(NP—9770160) Electric power consumption in private households - annual load curves of the electric power consumption of private households in Western Berlin. Regional final report.** Duewall, P. (Berliner Kraft- und Licht (BEWAG)-A.G. (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesministerium fuer Wirtschaft, Bonn (Germany, F.R.)). Dec 1986. 154p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770160/JAW.

Discussing a number of different concepts the study refers to a recently developed model which with the aim of replacing power plant reserves intends to control the disconnection of high-capacity household appliances. It is a changed reserve strategy wanting to either reduce both the power plant fleet and interruption reserves or put off the construction of new power plants. The research program analyzing the load curves of private households in the Feder-

al Republic of Germany is a BEWAG-suggested program providing a reliable foundation for discussing the extent and efficiency of the different concepts developed. Apart from determining the households' share in public supply load curves the program assesses the electric appliances habits of users in order to analyze the distribution of loads in private households. Supported by BMFT/BMWi six utility companies joined to engage in the project. Planning a representative survey of Western Berlin BEWAG took charge of more than 100 out of 400 random household tests representative for the Federal Republic of Germany. The time-dependent electric power consumption of the BEWAG supply region was recorded from Nov. 1980 to Sept. 1982. Approximately 260 million measurement results were stored on a mainframe for evaluation purposes.

7952 **(PB—89-100846/XAB) Regional application of natural-gas-fired combined-cycle power generation. Final report, March 1984-March 1988.** Gillette, J.L.; Poch, L.A.; Buehring, W.A. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Mar 1988. 133p. NTIS, PC A07/MF A01.

Use of gas-fired combined-cycle technology (GFCC) in the electric-utility sector could play an important role in a least-cost planning strategy and thereby provide significant benefits to the utilities and their customers. Potential benefits include reduced capital and operating costs, more-effective matching of load growth and capacity additions, greater system reliability, and reduced environmental emissions. GFCC technology was examined in eight utility systems in six geographic regions to estimate the potential benefits of its use. In all systems, GFCC technology was shown to have the potential to reduce the cumulative capital costs for adding new capacity. The overall conclusion of the study is that GFCC technology offers the potential for significant savings in many regions of the United States and that these benefits would appear over a wide range of economic conditions. The study provides insight into the important technological and economic factors influencing the competitiveness of GFCC power generation.

7953 **(PB—89-106561/XAB) Health-hazard evaluation report HETA-86-422-1891, City of Ames Municipal Power Plant, Ames, Iowa.** Ahrenholz, S.H. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 59p. (HETA—86-422-1891). NTIS, PC A04/MF A01.

In response to a request from the management of the Municipal Power Facility, Ames, Iowa and the International Union of Electrical Workers Local 234, an evaluation was made of possible health hazards at the work site. Concerns were specifically expressed about the handling and burning of refuse-derived fuel (RDF), asbestos insulation, coal dust, fly ash, hot working environments, polychlorinated biphenyl (PCB) present in grounding transformers, and on site chemical usage and storage. RDF was composed primarily of the shredded combustible part of municipal solid waste. A survey of the facility indicated that potential hazards did exist from noise, heat, asbestos, coal dust, and crystalline silica. The only documented case of over exposure was to coal dust in the coal yard. Metal exposure was very low or nondetectable. The author concludes that hazards existed due to heat levels, noise, potential asbestos exposure, and elevated coal dust and silica exposures. The author makes recommendations.

7954 **(PB—89-107304/XAB) Private-sector power generation in Thailand: potential, impediments, and policy issues. Final report.** (Hagler, Bailly and Co., Washington, DC (USA)). Nov 1986. 167p. NTIS, PC A08/MF A01.

The Royal Thai Government (RTG) is exploring ways of involving the private sector in electricity generation. The study: (1) assesses the sector's potential for non-utility power generation, including such options as industrial cogeneration, agricultural-waste-based energy systems, and large-scale systems using domestic fossil fuels; (2) reviews existing power-sector institutions in Thailand and analyzes the major issues and impediments associated with private-sector power generation; and (3) based on U.S. experience, describes possible approaches to establishing the price of non-utility electricity.

7955 **(PB—89-113450/XAB) Electric utilities sales and revenue monthly report (EIA-826), 1987. Data file.** Curry, J.; Wilkins, S. (National Energy Information Center, Washington, DC (USA)). 1987. mag tap. NTISCP T02.

See also PB—88-110598, PB—86-211513, and PB—85-200384. Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products.

The purpose of Form EI-826 formerly FERC-5, Electric Utility Company Monthly Statement, is to collect data necessary to fulfill regulatory responsibility; identify near-term trends in energy use; and contingency analysis. The form is filed monthly by approximately 150 electric utilities. All privately owned electric utilities with annual electric operating revenues of $100,000,000 or more must respond. In addition, the sample includes other selected electric utilities. The reported data is expanded by factors, calculated using annual data from a previous period, to give electric sales data by state and sector. Other information collected includes data gathered on depreciation, construction, net income before taxes, and extraordinary items.

7956 **(PB—89-115869/XAB) Knowledge-based system for real-time operation planning and event analysis in power-system control. Research note.** Keronen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Lab.). 1988. 113p. (VTT/RN—883). NTIS, PC E05/MF A01.

The aim was to develop a knowledge-based system for real-time operation planning in a power-system control center. During the study a prototype system called EKA was developed for the power system of the Helsinki Energy Board. The prototype is implemented with object-oriented techniques and it includes a complete model of the 110-kV transmission network and knowledge for the generation and testing of switching sequences. The study demonstrated that the solution method is suitable for the problem. The use of the expert system reduces routine work of the operators and gives them more time to think about the real problems. The major advantages of the system are the easiness of the user interface and the domain-oriented representation of the network.

7957 **(OA-Trans—2954) Organisational bases of the electricity supply industries in the member states of the European community.** Hermann, H.P. (Electricity Council, London (UK). Overseas Relations Branch Translations Service). 21 Jun 1988. Translated from German. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89004465/JAW.

This report contains: previous national concepts of the electricity supply industries; move towards a European view of the ESI's; and structural factors in the European electricity market.

## 2980 Consumption And Utilization

*REFER ALSO TO CITATION(S) 7947, 7950, 8036, 8044*

7958 **(NP—9770173) Energy consumption and energy conservation in the Baden-Wuerttemberg fruit and vegetable industry. Final report.** Mielicke, U.; Mueller, A. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung; Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). [1988]. 95p. (In German). NTIS (US Sales Only), PC A05. Order Number DE89770173/JAW.

The study focuses on the products which with regard to their total production value are the most important ones of the Baden-Wuerttemberg fruit and vegetable industry: - fruit juice (mainly apple juice stored as clear or concentrated juice, apple juice bottling), - pickles (sauerkraut, cucumbers, pickled vegetable). The data compiled largely refer to the processing procedures and machinery used by the target group, i.e. the small- and medium-scale enterprises. The pamphlet aims at informing the enterprises

about the energy consumption and main sources of energy consumption of their production processes, instructing them in analyzing their energy consumption, and pointing out feasible energy conservation measures. Due to the large variety of existing and potential information, the pamphlet can but supply approximate data and clues and cannot replace an intensive spot research and individual consultation.

### 2990 Unconventional Sources And Power Generation

*REFER ALSO TO CITATION(S) 7546, 7547, 7548, 7549, 7550, 7584, 7605, 7634, 7923, 7945, 7954*

7959 **(NP—9770157) Use of biomass as environment strategy in rural areas. Integrated supply concepts using as example rural communities in Denmark.** Krawinkel, H. (Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.)). Apr 1987. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770157/JAW.

In various rural regions in Denmark, a development policy has been in operation for several years, which assesses the specific energy and environmental problems of these parts of the country and is in search of integrated solutions. The problem of these regions of Denmark are basically not different from those in similar areas in the Federal Republic. An important starting point was seen in Denmark in the increased use of the energy content of organic waste. By using biogas, it was expected, apart from the advantages for energy supply, that this would also contribute to solving environmental pollution. The focal point of this essay are the municipal, regional and state activities, whose further development and coordination have led to, or are supposed to lead further to a considerable improvement of the technical, economical and organisational margin conditions of the production and use of biogas. The activities and their development are presented using various examples, and their transferability onto the Federal Republic investigated.

7960 **(NP—9770158) Biomass and use of wind power as environmental and development strategy for rural districts. Integrated technology and development policy in Denmark.** Krawinkel, H. (Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.)). Sep 1987. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770158/JAW.

The potential of the renewable energy sources biogas and straw, which has been established up till now could meet about 25 to 30% of Denmark's heat requirements. Approximately half of this potential is to be realised until the year 2000. With wind energy, the technical potential is much higher than the share of 'wind power', which can be integrated into the electricity supply system without technical problems. The Danish Energy Ministry assumes that up until 1995 a maximum of 10% of power production will come from wind power plants. The most important elements of Danish energy policy are: A national, widespread secialist planning of heating, energy delivery to imported energy carriers, research and product promotion programs and measures and agreements with the supply economy

7961 **(NRC/E—8007) Research and development in bioenergy; summary of the program to March 1980.** Summers, B.A. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1980. 225p. (In French). (CE—02125). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document is intended to give a general survey of the Canadian research and development program in bioenergy and information on individual projects. The primary overall objective of the program is the evaluation of resources and biomass conversion technologies. Most projects are contracted to the private sector by the various agencies concerned; administration of the program is by a consultative committee and research is oriented by the National Research Council. Specific projects are described under the headings of resource evaluation (forest residues, forest biomass, energy plantations, agricultural wastes, and marine biomass); environmental effects of silviculture, biomass harvesting, and biomass conversion technologies; international participation in short-rotation cultivation and information services; harvesting and compacting technology; conversion technologies (methane production, gasification, combustion, alcohol production, pyrolysis, and production of charcoal, liquid fuels, chemical feedstocks, and electricity); basic studies such as fermentation, heat storage and photosynthesis; socio-economic-technical studies (social infrastructure, information, economic and technical evaluation); supply, transport and pretreatment; and program management. Information given for each project includes objectives, principal researcher and contractor, financing, status, project description, and reports (if any) published. Includes index of researchers and contractors or participating agencies. 80 refs., 3 tabs.

## 30 DIRECT ENERGY CONVERSION

7962 **(AD-A—199103/3/XAB) Electrical resistivity, magnetic susceptibility, thermoelectric power, and heat capacity of $PtGa_2$. Technical report No. 11, August 1987-July 1988.** Hsu, L.; Zhou, L.W.; Machado, F.L.; Williams, R.S. (California Univ., Los Angeles (USA)). 22 Jul 1988. 18p. NTIS, PC A03/MF A01.

The electrical resistivity (p), magnetic susceptibility (chi), thermoelectric power (S), and specific heat (Cp) of PtGa2 were measured as a function of temperature (T). The metallic behavior of this intermetallic compound is shown from the room-temperature resistivity value (19 micro ohm-cm) and the linear dependence of the S vs. T curve at temperatures above the Debye temperature (theta D). The diamagnetic susceptibility is independent of T. The density of states (DOS) at the Fermi energy (EF) obtained from chi and S data agree within 22% and 15%, respectively, of the value obtained previously from a semi-empirical band structure calculation. The low-temperature Cp data, however, yielded a much smaller DOS at EF. The data for $PtGa_2$ are compared to those for Au and AuGa2 in order to better understand the transport properties of this material.

### 3001 Mhd Generators

*REFER ALSO TO CITATION(S) 7965*

7963 **(DOE/ET/15601—T46) Diagnostic development and support of MHD test facilities: Technical progress report for the period October, November, and December 1986.** Shepard, W.S.; Cook, R.L. (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Jan 1987. Contract AC02-80ET15601. 34p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003304/JAW.

Mississippi State University is developing diagnostic instruments for MHD power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for HRSR support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with MHD Energy Center computers. Additionally, technical support of the diagnostic needs of the national MHD research effort is being provided. 17 refs., 2 figs., 2 tabs.

### 3003 Thermoelectric Generators

7964 **(AD-A—199178/5/XAB) Study on iron disilicide thermoelectric generator. Periodic report No. 2.** Stockholm, J.G.; Scherrer, H.; Schlicklin, P. (Tunzini Nessi Entreprise Equipement, Rueil-Malmaison (France)). Jun 1988. 93p. NTIS, PC A05/MF A01.

A theoretical study is reported on the thermoelectric material, iron disilicide. The N type is doped with Co, the P type can either be doped with Al or Mn. A small prototype is built enabling heat-flux measurements. The efficiencies were measured for the KOMATSU couples which have Al-doped P-typed logs. The unit produced 0.75 watts with 18 couples. The efficiency of a couple alone (ration of electrical power by thermal power through the couple) is around 1%.

7965 **(JPL-D—5698) Direct conversion technology: Annual summary report CY 1988.** Massier, P.F.; Bankston, C.P.; Fabris, G.; Kirol, L.D. (National Aeronautics and Space Administration, Washington, DC (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1 Dec 1988. Contract AI01-86CE90237. 68p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89003911/JAW.

The overall objective of the Direct Conversion Technology task is to develop an experimentally verified technology base for promising direct thermal-to-electric energy conversion systems that have potential application for energy conservation in the end-use sectors. This report contains progress of research on the Alkali Metal Thermal-to-Electric Converter (AMTEC), and on the Two-Phase Liquid-Metal MHD Electrical Generator (LMMHD) for the period January 1988 through December 1988. Research on these concepts was initiated during October 1987. In addition, status reviews and assessments are presented for thermomagnetic converter concepts and for thermoelastic converters (Nitinol heat engines). Reports prepared on previous occasions contain discussions on the following other direct conversion concepts: thermoelectric, pyroelectric, thermionic thermophotovoltaic and thermoacoustic; and also, more complete discussions of AMTEC and LMMHD systems. A tabulated summary of the various systems which have been reviewed thus far has been prepared. Some of the important technical research needs are listed and a schematic of each system is shown. These tabulations are included herein as figures. 43 refs., 26 figs., 1 tab.

## 3004 Thermionic Converters

7966 **(DOE/CE/40715—T2) Sodium Heat Engine evaluation.** (Energetics, Inc., Columbia, MD (USA)). 10 Feb 1986. Contract AC01-84CE40715. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003882/JAW.

The purpose of the trip was to comply with the subject task order which requires an evaluation of the Sodium Heat Engine research and development project being sponsored by your office. 1 fig.

## 3005 Fuel Cells

*REFER ALSO TO CITATION(S) 7852, 7855, 7857, 9085, 9086*

7967 **(AD-A—197971/5/XAB) Development and demonstration of Microcomputer Intelligence for Technical Training (MITT). Final technical paper, July 1987-January 1988.** Johnson, W.B.; Hunt, R.M.; Duncan, P.C.; Norton, J.E. (Search Technology, Inc., Norcross, GA (USA)). Aug 1988. 43p. NTIS, PC A03/MF A01.

The Microcomputer Intelligence for Technical Training research described here is founded upon a proven intelligent diagnostic training simulation to construct enhanced models of the student, instructor, and expert in a training environment. An off-the-shelf microcomputer was used to deliver an operational intelligent tutoring system (ITS) with 180 days of project start. The demonstration ITS was developed in cooperation with Air Force and NASA personnel at the Lyndon B. Johnson Space Center in Houston, Texas. The space-shuttle fuel cell was the technical domain for this first application. Initial trial use by astronauts, flight controllers, and technical-training personnel indicates that the approach is technically feasible and has instructional value for space training applications.

7968 **(CONF-881010—3) Argonne MCFC cathode development.** Smith, J.L.; Kucera, G.H.; Brown, A.P. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01. Order Number DE89000608/JAW.

From 11. fuel cell seminar: development and application of fuel cells for the 90's; Long Beach, CA, USA (23 Oct 1988).

Work is underway at ANL to develop an alternative cathode to the NiO structure currently used in molten carbonate fuel cells. Cathode development consists of efforts in three areas. The first is to experimentally find stable, conductive ceramics that meet known materials requirements; the second is to develop methods for fabricating the complex cathode microstructure needed for cell use; the last is to evaluate alternative cathode performance. The first effort led to the development of several materials (copper-, cobalt-, and manganese-doped $LiFeO_2$ and magnesium-doped $Li_2MnO_3$) that all have resistivities meeting the level we projected through use of the cathode model developed by Physical Sciences, Inc. (PSI). Therefore, recent work has focused on anode and cathode structure development and analyses, and on in-cell verification of the new fabrication techniques. With the successful demonstration of the fabrication techniques with NiO cathodes, current emphasis is being placed on testing of the alternative cathode materials. 2 refs., 4 figs.

7969 **(CRIE-T—87022) Assesment of technology and application to gas separation membrane on molten carbonate fuel cell system(Part 1). Investigation of $CO_2$ separation process.** Asakawa, Chuhei; Watanabe, Takao; Isaki, Yoshiyuki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 57p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88755704/JAW.

The gas separation membrane was applied to the molten carbonate fuel cell(MCFC). It is essential to supply $CO_2$ to the cathode to continue the reaction and the same amount of $CO_2$ generated at the anode was used as the supplying source. The power generating efficiency was lowered because the nonreacted H2 and CO of anode exhaust gas were now burnt to $CO_2$. The performance may be improved if the $CO_2$ in the anode exhaust gas will be separated by the gas separation membrane and simultaneously nonreacted $H_2$ and CO will be circulated at the anode. The overall generated power(A) and sending end efficiency(B) were higher by 1.3% and 0.6% respectively in the hot potassium carbonate process than the combustion process. A and B were higher by 7.5% and 3.7% in the anode exhaust gas processing method using porous membrane. Further A and B were +1.5% and -0.7% in the polyimide(PM) membrane but were increased to 3.1% and 1.6% when the $CO_2$ partial pressure was elevated by separating and recovering nonconsuming $CO_2$ in the cathode exhaust gas. It is necessary to improve the distribution of pore for the porous membrane and to improve the permeating rate for PM. (62 figs, 12 tabs, 2 refs)

7970 **(CRIE-U—87050) Fabrication of carbon fiber electrode with platinum particles on its surface.** Saiki, Hiroshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1988. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A03. Order Number DE88755719/JAW.

Fabrication of carbon fiber micro-electrodes carrying platinum catalyst particles on their surfaces was attempted to apply to electrodes of fuel cells as well as to diversify their features as a sensor. Platinum was dispersed onto bare carbon fiber electrodes as easily as glassy carbon electrodes, and in addition, to increase the chemical and physical stability of platinum particles, it was attempted to disperse platinum into nafion high polymer films electrocoated on electrodes. However, since platinum was dispersed insufficiently onto the nafion coated electrodes, it was attempted to disperse platinum into pin-holed nafion films through pin-holes. Consequently, sufficient results and the outlook for development of the carbon fiber electrodes carrying platinum were obtained. Only films of about 600 micron in length were obtained by this method, so that a fabrication method of films of 10 cm or more in length for electrodes was remained for future studies. (3 figs, 1 photo, 1 tab, 6 refs)

7971 **(DOE/NASA—0017-5) Mathematical modeling of solid oxide fuel cells.** Lu, Cheng-Yi; Maloney, T.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Cleveland State Univ., OH (USA). Dept. of Chemical Engineering). Aug 1988. Contract AI21-80ET17088. 10p. (NASA-CR—182188; CONF-881010—4). NTIS, PC A02/MF A01 - OSTI. Order Number TI89003417/JAW.

From 11. fuel cell seminar: development and application of fuel cells for the 90's; Long Beach, CA, USA (23 Oct 1988).

Development of predictive techniques, with regard to cell behavior, under various operating conditions, is needed to improve cell performance, increase energy density, reduce manufacturing

cost, and to broaden utilization of various fuels. Such technology would be especially beneficial for the solid oxide fuel cell (SOFC) at its early demonstration stage. This paper describes the development of computer models to calculate the temperature, CD, and reactant distributions in the tubular and monolithic SOFCs. Results indicate that problems of nonuniform heat generation and fuel gas depletion in the tubular cell module, and of size limitations in the monolithic (MOD 0) design may be encountered during FC operation. 2 refs., 6 figs.

7972 **(EPRI-AP—6071) Endurance testing of a high-efficiency steam reformer for fuel cell power plants: Final report.** Udengaard, N.R.; Christiansen, L.J.; Summers, W.A. (Electric Power Research Inst., Palo Alto, CA (USA); Haldor Topsoe, Inc., Houston, TX (USA); Westinghouse Electric Corp., Large, PA (USA). Advanced Energy Systems Div.). Oct 1988. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001591/JAW.

This final report documents the results from demonstration and endurance tests, conducted in 1987 and 1988, of the Haldor Topsoe Heat Exchange Reformer. The primary objectives of this EPRI project were to develop, test and verify fuel processing components suitable for use in a Westinghouse Electric Corporation 7.5-MW phosphoric acid fuel cell power plant. EPRI's project is part of a larger national program sponsored by the Department of Energy to develop the technology and systems which are technically and economically viable for electric utility power generation applications. 26 figs., 11 tabs.

7973 **(FCP-TR-DOS-SY—026) Fuel cells for space use. Final report.** Knoebel, U. (Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.)). Aug 1987. 222p. (ESA-CR(P)—2563; ETN—88-93015). NTIS, PC A10/MF A01.

Hermes fuel cell requirements were analyzed, and the state of the art in Europe was reviewed. A computerized mathematical model for system simulation was established, and mobile and immobile KOH systems and SPE systems were analyzed. A system decision is not possible. A development plan is proposed.

7974 **(N—88-30184) Regenerative fuel cell energy storage system for a low earth orbit space station.** Martin, R.E.; Garow, J.; Michaels, K.B. (United Technologies Corp., South Windsor, CT (USA)). 1988. 139p. (NASA-CR—174802; FCR—6128; NAS—1.26:174802). NTIS, PC A07/MF A01.

A study was conducted to define characteristics of a Regenerative Fuel Cell System (RFCS) for low earth orbit Space Station missions. The RFCS's were defined and characterized based on both an alkaline electrolyte fuel cell integrated with an alkaline electrolyte water electrolyzer and an alkaline electrolyte fuel cell integrated with an acid solid polymer electrolyte (SPE) water electrolyzer. The study defined the operating characteristics of the systems including system weight, volume, and efficiency. A maintenance philosophy was defined and the implications of system reliability requirements and modularization were determined. Finally, an Engineering Model System was defined and a program to develop and demonstrate the EMS and pacing technology items that should be developed in parallel with the EMS were identified. The specific weight of an optimized RFCS operating at 140 F was defined as a function of system efficiency for a range of module sizes. An EMS operating at a nominal temperature of 180 F and capable of delivery of 10 kW at an overall efficiency of 55.4 percent is described. A program to develop the EMS is described including a technology development effort for pacing technology items.

7975 **(N—89-10409) Oxygen electrode bifunctional electrocatalyst $NiCo_2O_4$ spinel.** Fielder, W.L.; Singer, J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1988. 22p. (NASA-TM—100947; E—4238; NAS—1.15:100947). NTIS, PC A03/MF A01.

A significant increase in energy density may be possible if a two-unit alkaline regenerative H2-O2 fuel cell is replaced with a single-unit system that uses passive means for H2O transfer and thermal control. For this single-unit system, new electrocatalysts for the O2 electrode will be required which are not only bifunctionally active but also chemically and electrochemically stable between the voltage range of about 0.7 and 1.5 V. NiCo2O4 spinel is reported to have certain characteristics that make it useful for a study of electrode fabrication techniques. High surface area NiCo2O4 powder was fabricated into unsupported, bifunctional, PTFE-bonded, porous gas fuel cell electrodes by commercial sources using varying PTFE contents and sintering temperatures. The object of this study is to measure the bifunctional activities of these electrodes and to observe what performance differences might result from different commercial electrode fabricators. O2 evolution and O2 reduction data were obtained at 80 C (31 percent KOH). An irreversible reaction (i.e., aging) occurred during O2 evolution at potentials greater than about 1.5 V. Anodic Tafel slopes of 0.06 and 0.12 V/decade were obtained for the aged electrodes. Within the range of 15 to 25 percent, the PTFE content was not a critical parameter for optimizing the electrode for O2 evolution activity. Sintering temperatures between 300 and 340 C may be adequate but heating at 275 C may not be sufficient to properly sinter the PTFE-NiCo2O4 mixture. Electrode disintegration was observed during O2 reduction. Transport of O2 to the NiCo2O4 surface became prohibitive at greater than about -0.02 A/sq cm. Cathodic Tafel slopes of -0.6 and -0.12 V/decade were assumed for the O2 reduction process. A PTFE content of 25 percent (or greater) appears to be preferable for sintering the PTFE-NiCo2O4 mixture.

7976 **(PB—89-100515/XAB) Phosphoric acid fuel-cell subsystem technology. Final report, February 1987-February 1988.** King, J.M.; Scheffler, G.W. (International Fuel Cells Corp., South Windsor, CT (USA)). Sep 1988. 64p. (FCR—9594). NTIS, PC A04/MF A01.

Subsystem improvements beyond those achieved in prior GRI and DOE approved activities were investigated. Concepts with reduced material and processing cost were investigated for the repeating elements of the cell stack. Initial evaluations of these concepts through fabrication trials, functional-performance, and material-properties investigations were successful. Several improvements to the fuel processor were investigated. An improved approach for operation on fuel gas containing oxygen was defined. A concept for improving efficiency was shown to be feasible in a rig test. Improved catalyst candidates for several fuel-processor functions were identified and a material was identified which would lead to reduced cost for a fuel-processing filter. An advanced power conditioner was identified that provides both improved operating capability and a 25% reduction in size compared to that used previously. Experimental hardware for evaluation of this concept was fabricated. An integrated controller was defined and an approach to providing both on-site and remote diagnosis of power plant problems was incorporated. Experimental hardware fabricated to evaluate this approach is half the size of the approach used previously. The advanced concepts evaluated in the program would result in an overall power plant size reduction of 30%. A power plant ventilation approach for all weather operation was defined.

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

*REFER ALSO TO CITATION(S) 7926, 7927*

## 3201 Buildings

*REFER ALSO TO CITATION(S) 7280, 7712, 7951, 8031, 8034, 8088, 8710, 9204, 9205, 9269, 9275, 9277, 9489, 9527*

7977 **(AD-A—197403/9/XAB) Building for energy conservation. Master's thesis.** Merton, R.E. (Scientists' Inst. for Public Information, New York (USA)). 1988. 99p. NTIS, PC A05/MF A01.

Contents include: why conserve energy; energy usage in building; energy losses in buildings; climatic effects and considerations; improving the efficiency of buildings; and alternate sources.

7978 **(AD-A—197925/1/XAB) Design and construction of an ice-in-tank diurnal ice storage for the PX building at Fort Stewart, GA. Final report.** Sohn, C.W.; Tomlinson, J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1988. 55p. (CERL-TR-E—88/07). NTIS, PC A04/MF A01.

Diurnal cold-storage cooling systems may be effective tools for reducing peak electrical demand at Army installations. Ice, water, or eutectic salts can be used to store refrigeration produced during offpeak hours. Then, during peak-load periods, the stored cold can be used to cool a facility. Such a reduction in the peak electrical demand can result in substantial savings in utility bills throughout the year. However, there is a lack of standard design guidance on these systems for Army engineers. As a first step toward remedying that situation, a demonstration ice-in-tank diurnal ice storage (DIS) cooling system was designed and installed--using standard engineering practices--at Fort Stewart, GA. Although the concept of cold storage is new, it can be implemented using familiar engineering procedures. This report documents the design and installation of the ice-in-tank system. The results of performance and operational testing will appear in a future technical report.

7979 **(AD-A—198953/2/XAB) Applying energy-conservation retrofits to standard army buildings: project design and initial energy data. Final report.** Westervelt, E.T.; Northrup, G.R.; Allen, E.O. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1988. 126p. (CERL-TR-E—88/08). NTIS, PC A07/MF A01.

This report describes the initial and continuing efforts in a project demonstrating the energy performance of theoretically-based retrofit packages on as-found, standard-design Army buildings. Four standard building designs are being investigated: a motor-vehicle repair shop, the Type 64 (L-shaped) barracks, an enlisted-personnel mess hall, and a two-company, rolling-pin-shaped barracks for enlisted personnel. The Army has over 840 of these particular buildings. The objective of the project is to test the energy and cost performance of the retrofit packages, which include such measures as installing wall or ceiling insulation, replacing and/or blocking windows, partitioning areas of differing temperature, modifying air-handling equipment, modifying boiler controls, replacing lights, etc. To this end, energy data has been gathered from retrofitted and identical but nonretrofitted buildings for a test/reference comparison.

7980 **(AMA—1987) The Poly Air Dam, a new plastic gasket to improve airtightness.** Powis, W.L. (Alberta Municipal Affairs, Edmonton (Canada). Innovative Housing Grants Program). 1987. 99p. (MICROLOG—88-03756). Alberta Municipal Affairs, Jarvis Bldg., 6th Floor, 9925-107 St., Edmonton, Alta., Canada T5K 2H9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Air leakage contributes significantly to the heating and cooling load in houses. Some of the major leakage pathways occur at the following junctions: bottom plate/subfloor, rim joist/top of foundation wall, and wall framing/window (door) jamb. Conventional construction practice does attempt to reduce air leakage at the bottom plate/subfloor junction, but there are few effective ways to seal the other two pathways. Effective techniques to accomplish this air seal do exist, but they tend to be difficult and/or expensive. The purpose of this project was to develop an effective, inexpensive, simple product and technique to seal these three pathways. The product is called the Poly Air Dam (PAD). To establish profile shape and composition, a plastics manufacturer was contacted. Prototype production was initiated. Laboratory testing, using an airtight chamber, compared the PAD to common methods of sealing the window and door jamb, and rim joist tests were conducted separately. The response of the construction community was assessed by providing product samples which were installed in several houses. Builders were interviewed to assess procedures, training requirements, problems, and costs associated with the PAD approach. The PAD systems were found to be as effective as systems presently used in super energy efficient and R-2000 houses, but far less expensive and easier to install. Industry response indicated a market exists for the product. 18 refs., 32 figs., 6 tabs.

7981 **(ARC/ITD—8709) Development of a testing procedure for paints used as vapor diffusion retarders.** (Alberta Research Council, Edmonton (Canada). Industrial Technologies Dept.). 1987. 51p. (MICROLOG—88-02106). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A testing method was developed to determine the water vapor permeance of paints and primers applied to gypsum wallboard, providing a range of permeance values of common paints and primers used in the residential construction industry. This was intended to provide technical information to building inspection departments in order to get support for using paints as air/vapor barriers instead of polyethylene, which has been found to have a number of disadvantages including deterioration and susceptibility to rupture by wind pressures. A testing procedure was developed using gypsum wallboard as a substrate. This procedure was then verified with respect to precision, reproducibility and ease of use. The method so developed was found to provide precise and reproducible permeance values, was easy to use, and relatively inexpensive. Alkyd sealers and enamels were found to be effective water vapor diffusion retarders, while latex primers and paints were not. 15 refs., 8 figs., 18 tabs.

7982 **(CONF-8703307—) Preventing fraud and abuse in low income weatherization programs: The proceedings of the EORI [Economic Opportunity Research Institute] Roundtable.** (Economic Opportunity Research Inst., Arlington, VA (USA)). 1987. Contract FG01-85CE63438. 177p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004104/JAW.

From Economic Opportunity Research Institute (EORI) Roundtable on preventing fraud and abuse in low income weatherization programs; Washington, DC, United States (23 Mar 1987).

The Economic Opportunity Research Institute (EORI) sponsored a national Roundtable on "Prevention of Fraud and Abuse in Low Income Weatherization Programs" in Washington, DC on March 23-24, 1987. Funding for the Roundtable and these Proceedings was provided jointly by the US Departments of Health and Human Services/Office of Family Assistance and Energy through Grant FG01-85CE63438. The purpose of the Roundtable was two-fold: (1) to share successful and possible replicable state and local measures to prevent fraud and abuse in low income conservation programs; and (2) to identify any areas in these programs where the potential for fraud and abuse may exist and examine methods to curb such potential. A Task Force representing eight states and including both state and local low income conservation program operators was chosen by EORI and the HHS Office of Family Assistance. The Agencies represented had developed successful preventive approaches to curbing fraud and abuse. Additional participants in the Roundtable included representatives from the US Department of Energy, Weatherization Assistance Program Office and the HHS Office of Energy Assistance, along with other state and local program operators.

7983 **(CONF-8809200—1) Presentation on building foundation handbooks and MEC insulation recommendations.** Christian, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 2p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004175/JAW.

From NAHB Standing Committee on Energy meeting; Reno, NV, USA (30 Sep 1988).

7984 **(CONF-8811113—1) A preliminary model of radon exposure.** Rogers, G.O.; Hummon, N.P.; Strom, D.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003408/JAW.

From Annual meeting on risk analysis; Boston, MA, USA (9 Nov 1988).

This paper develops a preliminary model of exposure to radon gases. This paper considers indoor and outdoor exposure to radon in residential and non-residential settings. Differential exposure associated with level of activity, age, duration and seasonal

variation are also considered. Dose equivalents to bronchial epithelium are estimated as the result of type of exposure, activity differentials, age differences, estimated length of exposure, and seasonal variation. The preliminary model of radon exposure draws on a variety of existing data relating to the social, technical and physical health characteristics of radon exposure. 24 refs., 8 tabs.

7985 **(DOE/BP—1115) Field performance of an energy-efficient refrigerator over 29 months.** Reinhart, R.E. (USDOE Bonneville Power Administration, Portland, OR. Office of Energy Resources). Nov 1988. 52p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004398/JAW.

This report represents and analyzes 29 months of field data from an energy-efficient refrigerator serving a family of four in Portland, Oregon. The refrigerator, an Amana model TC20G, was one of the most efficient American made models then available. Data for the first 5 months, August through December of 1985, and their analysis are presented in Appendix A. The data for 1986 and 1987 are presented in Appendix B. Cumulative energy use in watt-hours, cumulative door openings, and maximum and minimum kitchen temperature were collected. Usually, these data were recorded daily in log books but there were some extended periods with no readings. Data analysis on this refrigerator produced the following definitive results: There was a high correlation coefficient (0.95) when average daily energy consumption per month was regressed against average daily kitchen temperature per month; There was a very low correlation (0.3) when average daily energy consumption per month was regressed against the average number of daily door openings per month; Energy use varied linearly and predictably with average daily kitchen temperature, but not with the number of door openings; Ignoring door openings, regression equations of energy use versus average daily kitchen temperature for 1986 and 1987 produced annual consumption estimates essentially identical with measured energy use; and Estimated and measured annual energy use was only 70 percent of that predicted by the Energy Guide label. 2 refs., 21 figs.

7986 **(DOE/BP/60326—1) Exhaust-air heat pump study: Experimental results and update of regional assessment for the Pacific Northwest.** Wallman, P.H.; Fisk, W.J.; Grimsrud, D.T. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AI79-86BP60326. 65p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004113/JAW.

This study focuses on one part of a large project. Phase one of that project assessed Pacific Northwest EAHP performance based on computer simulations. This phase focuses on laboratory evaluations of EAHP performance and a brief update to the preliminary assessment. (A later phase will conduct a field study of EAHPs.) Researchers monitored the performance of two EAHP systems scheduled for marketing in North America. One system was evaluated with and without operation of an optional fan-coil condenser which can be used to deliver recovered energy to the indoor air. The two units were notably different in one respect: location of the water heating condenser (surrounding the tank vs. in the lower quarter of the tank). The study examined inlet air temperature, humidity, and flow rate; water demand volume and schedule; inlet water temperature; and thermostat set points. Primary measures of performance were the coefficient of performance (COP) and the energy savings relative to electric-resistance heating. The meters and other components of the measurement system were finely cross-checked and correlated to minimize errors. In the water-heating mode, the heat pumps were tested in 24-hour runs; for space-heating, tests ran 6 hours because the fan-coil tests reached steady state rapidly. The units were also tested in a combined water- and space-heating mode. The data obtained were used to confirm and update the computer model used in phase one. 3 refs., 12 figs., 5 tabs.

7987 **(DOE/EA—0318) Environmental assessment of SP-100 ground engineering system test site: Hanford Site, Richland, Washington.** (USDOE, Washington, DC). Dec 1988. 279p. NTIS, PC A13/MF A01 - OSTI. Order Number DE89004400/JAW.

The US Department of Energy (DOE) proposes to modify an existing reactor containment building [decommissioned Plutonium Recycle Test Reactor (PRTR) 309 Building] to provide ground test capability for the prototype SP-100 reactor. The 309 Building (Figure 1.1) is located in the 300 Area on the Hanford Site in Washington State. The National Environmental Policy Act (NEPA) requires that Federal agencies assess the potential impacts that their actions may have on the environment. This Environmental Assessment describes the consideration given to environmental impacts during reactor concept and test site selection, examines the environmental effects of the DOE proposal to ground test the nuclear subsystem, describes alternatives to the proposed action, and examines radiological risks of potential SP-100 use in space. 73 refs., 19 figs., 7 tabs.

7988 **(DOE/SF/15256—T1) Data collection and model development of liquid desiccant integrated HVAC System: Phase II, Final report.** (Gershon Meckler Associates, P.C., Herndon, VA (USA)). 1 Dec 1988. Contract AC03-84SF15256. 69p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004761/JAW.

The purpose of this project is to validate a generic model of an innovative liquid desiccant dehumidification integrated HVAC system. The existing liquid desiccant integrated HVAC system operating in the Science Museum of Virginia at Richmond affords an excellent opportunity for a systematic evaluation of a liquid desiccant dehumidifier with several selective energy subsystems already in place. The original scope of the Phase II effort included development of models for the dehumidifier subsystem, development of models for the other integrated HVAC system components, testing of the integrated HVAC system in several operating modes, and development and verification of models of the integrated system when operating in these modes. In view of the problems experienced with the DADM system, however, all parties involved agreed that the Phase II effort should focus on the development and verification of a model of the dehumidifier subsystem.

7989 **(DOE/SF/17301—T1) Research and development of a static optical system to reduce apparent motion of the sun: Final report.** (Lighting Sciences, Inc., Scottsdale, AZ (USA)). 30 Nov 1988. Contract AC03-87SF17301. 84p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004152/JAW.

This project has been undertaken to develop an optimum design for lensing which will reduce the apparent daily and seasonal motion of the sun. The goal of the work has been to produce a lens onto which sunlight falls over its wide range of angles, yet have the transmitted light lie within a restricted angular range. Using computer simulations, a large number of optical designs have been investigated, both complex and simple. Lenses were evaluated in terms of the lumens transmitted and the uniformity of transmission during the working day and throughout the year. Lens designs which provide very high transmittance were discovered, but it has been found that the period of transmittance is only a few hours per day. Other designs were developed with only a moderate transmitting efficiency, but which produce light in the useful angular range over virtually all of the day without major fluctuations. The effect of seasonal variation on such lenses also has been evaluated. Performance analysis has been presented for all lenses found to have useful characteristics, and the researchers believe that different lenses will perform best depending upon the nature of the application. However, it has been determined after detailed analysis that a relatively simple form of lens will outperform complex designs for most applications. 61 figs.

7990 **(DOE/SF/17301—T1-App.) Research and development of a static optical system to reduce apparent motion of the sun: Final report: Appendices.** (Lighting Sciences, Inc., Scottsdale, AZ (USA)). 30 Nov 1988. Contract AC03-87SF17301. 83p. NTIS, PC A04/MF A01 - OSTI. Order Number TI89004153/JAW.

This is the Appendices to the report, "Research and Development of a Static Optical System to Reduce Apparent Motion of the Sun." (FI)

7991 **(EPRI-EM—6151) Measurement of differential pressures and radon entry in research houses and evaluation of radon control methods: Final report.** Fortmann, R.C.; Rector, H.E.; Nagda, N.L. (Electric Power Research Inst., Palo Alto, CA (USA); GEOMET Technologies, Inc., Germantown, MD (USA)). Dec 1988. 95p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004707/JAW.

Experimental testing was conducted in two well-insulated bi-level research houses to evaluate the effectiveness of selected radon and radon progeny control methods and to develop a fuller understanding of the relationship between indoor-outdoor pressure differences and radon entry. Radon, radon progeny, indoor and outdoor temperatures, air infiltration rates, pressure differences, and meteorological conditions were measured continuously with an automated system. Radon and radon progeny control methods were tested in one house; the other house served as a reference to avoid the confounding effects of natural radon variation on calculations of control effectiveness. Differences in pressure between indoors and outdoors or indoors and the subslab airspace averaged less than 2 pascals throughout the year. Pressure differences were consistent with indoor-outdoor temperature differences; the downstairs of the houses were depressurized with respect to outdoors during the winter and pressurized during the summer. Seasonal differences in radon entry rates were consistent with general patterns of indoor-outdoor pressure differences, but regression techniques did not show strong correlation between pressure differences and radon entry rates. The subslab suction system was the most effective of the radon control methods tested. Radon progeny control devices tested, including common household appliances, such as ceiling fans, portable air cleaners, and electronic precipitators, reduced radon progeny levels by as much as 70 percent. 26 refs., 21 figs., 12 tabs.

7992 **(K/CSD/TM—80) Heat loss through building envelopes due to convective loops.** Park, J.E.; Kirkpatrick, J.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1988. Contract AC05-84OT21400. 86p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004507/JAW.

The convective motion of air trapped in a building cavity can, under some circumstances, increase the amount of energy lost through the cavity greatly over that expected from a conduction-based analysis. The behavior and economic consequences of such "convective loops" are not well understood. To gain some insight into the thermal behavior of the loops and into the prospects for numerical simulation as a means of evaluating that behavior, computer models for a few such loops have been developed. In this report, those models are described, solutions for two loops are presented, and the prospects for analysis of several other loops are examined. 12 refs., 28 figs., 6 tabs.

7993 **(LBL—22474) Potential risks from exposure to organic carcinogens in indoor air.** McCann, J.; Horn, L.; Girman, J.; Nero, A.V. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 31p. (CONF-8610446—1). NTIS, PC A03 - OSTI. Order Number DE89002916/JAW.

From EPA symposium on the application of short-term bioassays in the analysis of complex environmental mixtures; Durham, NC, USA (20 Oct 1986).

We have examined the current literature reporting concentrations of organics in indoor environments to construct a nominal list of indoor air concentrations for 140 compounds. We have gone on to examine, in a preliminary way, the potential risk of various health endpoints from indoor air exposure to these substances. An important component of this study has been to examine risks for the carcinogens among these substances. We here report our preliminary assessment of cancer risks from exposure to 24 carcinogens, using several analytical approaches. 70 refs., 5 tabs.

7994 **(LBL—23097) Higher mortgages, lower energy bills: The real economics of buying an energy-efficient home.** Mills, E. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 20p. (CONF-8704333—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002960/JAW.

From 5. annual international energy efficient building conference and exposition; Minneapolis, MN, USA (9 Apr 1987).

To measure the actual costs and benefits of buying an energy- efficient home, it is necessary to employ a cash-flow model that accounts for mortgage interest and other charges associated with the incremental costs of conservation measures. The ability to make payments gradually over the term of a mortgage, energy savings, and tax benefits contribute to increased cost effectiveness. Conversely, financial benefits are reduced by interest payments, insurance, taxes, and various fees linked to the (higher) sale price of an energy-efficient home. Accounting for these factors can yield a strikingly different picture from those given by commonly used "engineering" indicators, such as simple payback time, internal rate of return, or net present value (NPV), which are based solely on incremental costs and energy savings. This analysis uses actual energy savings data and incremental construction costs to evaluate the mortgage cash flow for 79 of the 144 energy-efficient homes constructed in Minnesota under the Energy-Efficient Housing Demonstration Program (EEHDP) initiated in 1980 by the Minnesota Housing Finance Agency. Using typical lending terms and fees, we find that the mean mortgage-NPV derived from the homeowners' real cash flow (including construction and financing costs) is 20% lower than the standard engineering-NPV of the conservation investment: $7981 versus $9810. For eight homes, the mortgage-NPV becomes negative once we account for the various mortgage-related effects. Sensitivities to interest rates, down payment, loan term, and marginal tax rate are included to illustrate the often large impact of alternative assumptions about these parameters. The most dramatic effect occurs when the loan term is reduced from 30 to 15 years and the mortgage NPV falls to -$925. We also evaluate the favorable Federal Home Administration (FHA) terms actually applied to the EEHDP homes. 8 refs., 4 figs., 3 tabs.

7995 **(NP—9770156) Thermal insulation and humidity.** Meier, C. (Stadt Nuernberg (Germany, F.R.). Baureferat). (Rationalisierungs-Gemeinschaft Bauwesen im RKW (RGB), Eschborn (Germany, F.R.)). 1987. 12p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770156/JAW.

The RG-Bau pamphlet 81 offers a survey on heat insulation, elucidated by way of numerous diagrams. Temperature curves for outside, core and inside insulation are presented as well as for monolithic construction and high K-values. Further information concerns thermal bridges and surface temperatures. Furthermore, information is given on humidity (condensation of damp air, surface condensation and K-values, partial aqueous pressure), and estimations, in terms of construction physics, are made of six constructions (constructive consequences). In conclusion, details are given on damage caused by dampness and its treatment (heat flow, condensation, steam diffusion and formation of condensation). (HWJ).

7996 **(NP—9770177) Modern central heating technology. A handbook of the Hessian Ministry for Economy and Technology.** (Hessisches Ministerium fuer Wirtschaft und Technik, Wiesbaden (Germany, F.R.)). [1988]. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770177/JAW.

The handbook 'Modern central heating technology' describes in a concentrated form the state of modern heating technology. The aim of the information booklet is to show the newly-developed basic components of central heating systems in their technical and economic connections to the system as a whole. The main emphasis is laid on low temperature heating, high efficiency boilers, the area of heating control, heating of industrial water, and the area of central heating modernisation as a whole.

7997 **(ORNL/Sub—84-21006/2) Structural thermal break systems for buildings: Development and properties of concrete systems: Final report.** Litvin, A.; Van Geem, M.G. (Oak Ridge National Lab., TN (USA); Construction Technology Labs., Skokie, IL (USA)). Oct 1988. Contract AC05-84OR21400. 79p. Q/MF A01 - OSTI. Order Number DE89004117/JAW.

This report presents results from the second phase of a three phase program to investigate lightweight concrete systems for po-

tential use as structural thermal breaks in buildings. The second phase of work, presented in this report, is the laboratory development and measurement of properties of the lightweight portland cement concrete. Work included materials selection and concrete mix development. Thermal and physical properties of the candidate concretes were measured on small-scale specimens. Data on concrete thermal conductivity, thermal diffusivity, specific heat, compressive strength, flexural strength, shear strength, splitting tensile strength, and modulus of elasticity are presented. Casting and surface finishing techniques for the most desirable mix are also described. 13 refs., 17 figs., 16 tabs.

7998 **(PB—88-252416/XAB) Energy analysis of multifamily housing rehabilitation measures.** Hunn, B.D.; Silver, S.C. (Texas Univ., Austin (USA). Center for Energy Studies). Jun 1988. 92p. (CONSERV-SOLAR-RR—6). NTIS, PC A05/MF A01.

Two apartment buildings, an 18-unit complex in Austin, Texas, and a 6-unit complex in Boston, Massachusetts, were analyzed to determine the cost-effectiveness of energy-efficiency measures applicable to each. Based on detailed audit data, supplemented by field-measured performance data in the case of the Austin apartment building, the DOE-2 simulations were run for base-case (preretrofit) conditions for each building. Annual energy and cost savings were calculated separately for each measure and for the combined measures considered as a set. For the Austin apartment building the combined set of 11 measures yielded expected savings of $3,710/yr, a 42 percent savings in site energy. The combination of the seven measures considered for the Boston apartment building yielded expected savings of $1,292/yr, and annual energy savings of nearly 75%.

7999 **(PB—88-252432/XAB) CBS/ICE program user's guide.** Silver, S.C.; Jones, J.W.; Peterson, J.L.; Milbitz, A.; Hunn, B.D. (Texas Univ., Austin (USA). Center for Energy Studies). Jun 1988. 223p. (CONSERV-SOLAR-RR—7). NTIS, PC A10/MF A01.

A wide variety of tools are available for the energy analysis of buildings. These range in complexity from manual degree-day-based approaches to bin methods (often performed on microcomputer spreadsheets) to sophisticated hourly simulation codes that typically run on mainframe computers. Few of these programs have the detailed algorithms necessary to model the different HVAC system and central plant configurations found in many commercial buildings. This report documents the development of an hourly computer-simulation program for modeling static (ice-on-coil) ice-storage systems to provide thermal storage in HVAC systems applications. The program, called CBS/ICE, is structured as part of the DOE-2/CBS building energy-analysis computer program, but can be run in a stand alone mode. It simulates, in detail, the seasonal energy use and peak-demand performance of HVAC systems incorporating ice storage for use by ice-storage-system designers.

8000 **(PB—88-253539/XAB) Development and application of a semiconductor pressure sensor for air conditioners.** Kobayashi, T.; Bessho, M.; Fukushima, A. (Mitsubishi Electric Corp., Tokyo (Japan)). 1988. 7p. NTIS, PC E05/MF A01.

Text in Japanese; Included in Mitsubishi Denki Giho, Vol. 62, No. 5, 17-22(1988).

The authors have used finite-element stress analysis to develop a semiconductor pressure sensor that is small, low-cost, and highly durable. It has the highest pressure tolerance in the industry, and also resists vibration and shock. The element and its temperature-compensation circuit are mounted in a highly insulated hermetic package. The sensor can be used to maintain the optimum refrigerant pressure, saving energy when inverter-controlled air conditioners operate at less than full capacity.

8001 **(PB—89-103725/XAB) Personal-computer field site data-acquisition-system operating manual. Topical report, January 1986-December 1987.** Malcosky, N.D.; Clay, P.A.; Herchline, L.E.; Kerr, G.H. (Columbia Gas System Service Corp., Columbus, OH (USA). Research Dept.). Jul 1988. 186p. NTIS, PC A09/MF A01.

The Research Department of the Columbia Gas System Service Corporation has developed a personal-computer-based site data acquisition system (DAS), and a modular data acquisition software package, including specific modules for acquisition of data from gas-engine heat pumps, and real-time calculation of COP. The DAS hardware and software have been implemented at 12 field-test sites nationwide, acquiring data from 1.8RT - 4RT gas-engine heat pumps. The DAS consists of an IBM personal computer (or 100% compatible clone); MetraByte data acquisition, counter/time and analog multiplexer/amplifier boards, EDA constant-current power supply and pulse train Debounce boards; and a Hayes 1200 baud modem. The software consists of the Columbia-designed, modular data acquisition, engineering unit conversion, data analysis, data display and data storage routines, and KTALK file dispatcher with bi-directional communication and error checking routines. The system stores operating system, data acquisition/analysis and communications software on one floppy-disk drive, and stores data in 60-kb data blocks on a second floppy-disk drive. The system scans up to 138 sensors every 15 seconds, and stores averaged data to disk every 15 minutes, or on every change in heat-pump operating mode.

8002 **(PB—89-114037/XAB) Effect of wall mass on the peak sensible heating and cooling loads of a single-family residence.** Burch, D.M.; Walton, G.N.; Licitra, B.A.; Cavanaugh, K.; Klein, M.D. (National Bureau of Standards, Washington, DC (USA)). Oct 1986. 33p. (NBSIR—86/3458). NTIS, PC A03/MF A01.

The effect of wall mass on the peak sensible heating and cooling loads of a single-family residence was investigated using a sophisticated computer program called the Thermal Analysis Research Program (TARP). The computer simulation accuracy was verified by comparing its predicted sensible heating and cooling loads to measured values for six test buildings each having different wall constructions at the National Bureau of Standards. Good agreement was obtained for the load comparisons. The computer program subsequently was used to simulate the performance of identical houses each having the following three insulated-wall constructions: wood frame, conventional masonry (outside wall mass), and innovative masonry (inside wall mass). When the house was operated with fixed thermostat settings, the effect of wall mass on the peak sensible heating and cooling loads was found to be less than 11% for the climatic regions analyzed. Operating the typical house with a 10°F (5.6°C) night temperature setback during an 8-hour night period caused the daily peak sensible heating loads to be approximately twice those without setback.

8003 **(PB—89-115273/XAB) Feasibility of a complex compound heat pump. Annual report, July 1987-June 1988.** Rockenfeller, U.; Langeliers, J. (Rocky Research Corp., Boulder City, NV (USA)). Jul 1988. 75p. NTIS, PC A04/MF A01.

See also PB—88-113022.

This report describes the feasibility study of a double-effect gas-fired heat pump using ammoniated solid-vapor complex compounds as the working media. The cycle takes advantage of the coordinative characteristic of complex compound-ligand bonds resulting in large coordination spheres with only one degree of freedom. The cycle has high efficiency, no moving parts, and minimum electrical parasitic requirements. Media properties of the candidate materials were experimentally verified with respect to stability, equilibrium pressure, and reactivities in adsorption and desorption processes. A bench-scale proof-of-concept system was constructed and operated. The computer model was complemented with media heat-capacity properties and coefficients of performance indicating COPc of about 1.0 and COPH of about 2.1 should be achievable.

8004 **(PB—89-116016/XAB) Healthy buildings '88: abstract guide (constructions saines '88: guide des resumes).** Berglund, B.; Lindvall, T.; Mansson, L.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 348p. (D—14:1988). NTIS, PC E12/MF A01.

A compilation of abstracts covers papers given at a 1988 international conference that focused on technical solutions and functional requirements contributing to improvements of the air quality of buildings in which people live and work. The papers were grouped among eight principal themes, viz.: keynote addresses and overview lectures; building location and planning; building

physics; thermal-climate technology; indoor air quality technology; quality assurance; and policy and regulatory science. Considerations were given to a wide variety of topics, including air pollution, climate, building tightness, indoor air pollution, measurement and diagnosis, and design recommendations.

8005 **(PB—89-126213/XAB) Aqueous absorption fluids. Annual report, July 1987-June 1988.** Rockenfeller, U.; Langeliers, J. (Rocky Research Corp., Boulder City, NV (USA)). Jul 1988. 87p. NTIS, PC A05/MF A01.

The report describes the first year of study of aqueous-based working fluids that allow for air-cooled absorption chiller operation. The successful development of such fluids will eliminate the need for cooling towers in gas-fired chiller equipment for residential and unitary markets and possibly allow for building heating with absorbed heat. Several candidate fluids were investigated experimentally, and three were found to exhibit significant potential increases in absorber temperature of 13 to 27 F. Two candidates were retained for further investigation next year. A computer model for a single-stage absorption cycle was developed. The model will predict the cycle performance when additional fluid data from a test sorber are available.

8006 **(PB—89-126239/XAB) Phases I-C, I-D and I-E development of Kinematic Stirling/Rankine commercial gas-fired heat pump system. Final report, January 1986-September 1988.** Monahan, R.E. (Stirling Power Systems Corp., Ann Arbor, MI (USA)). Oct 1988. 101p. NTIS, PC A06/MF A01.

The Kinematic Stirling/Rankine gas-heat-pump concept is based on the application of a Stirling engine under development for over a decade. The engine was converted to natural gas and is characterized with many thousand hours of operating experience. The goal of the project is to develop a commercial-size Stirling engine-driven gas heat pump with a cooling capacity of 10-tons, a COP (heating) of 1.8 and a COP (cooling) of 1.1. The project is a multi-phase development with commercialization planned for 1990. In these phases, an HVAC systems manufacturer (York International) has been working with SPS to develop a prototype gas-heat-pump system. To date, two generations of prototype GHP systems have been built and tested and have demonstrated significant operating cost savings over the conventional electric heat pump. Data are presented for environmental laboratory testing of both prototype gas heat pumps as well as durability, reliability, performance, and emission testing of the V160 Stirling engine. A number of design and manufacturing process changes were made to the engine to reduce costs and improve endurance and shaft efficiency and are described.

8007 **(SERI/TP—254-3402) Improving gas-fired heat pump capacity and performance by adding a desiccant dehumidification subsystem.** Parsons, B.K.; Pesaran, A.A.; Bharathan, D.; Shelpuk, B.C. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1988. Contract AC02-83CH10093. 25p. (CONF-890105—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE88001196/JAW.

From ASHRAE winter symposium; Chicago, IL, USA (28 Jan 1989).

This paper examines the merits of coupling a desiccant dehumidification subsystem to a gas-engine-driven vapor compression air conditioner. A system is identified that uses a rotary silicia-gel parallel-plate dehumidifier. Dehumidifier data and analysis are based on recent tests. The dehumidification subsystem processes the fresh air portion and handles the latent portion of the load. Adding the desiccant subsystem increases the gas-based coefficient of performance 40% and increases the cooling capacity 50%. Increased initial manufacturing costs are estimated at around $500/ton ($142/kW) for volume production. This cost level is expected to reduce the total initial cost per ton compared to a system without the desiccant subsystem. 19 refs., 8 figs., 5 tabs.

8008 **(OA-Trans—2935) The development of electric heating in Europe: An overview.** (Ministere de l'Industrie, des P et T et du Tourisme, 75 - Paris (France)). Jul 1988. Translated from report commissioned from "Potentiel Energie," Paris, by Observatoire de l'Energie, March 1988. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89004471/JAW.

This report discusses several aspects of electric heating in Europe which are: the share of electric heating in existing homes; the share of electric heating new homes; the different electric heating systems; regulations on electric heating; and electricity tariff structure for heating. These topics are then covered in particular, as they relate to France.

8009 **Performance evaluation of energy-saving measures.** Piette, M.A.; Anderson, B. (Lawrence Berkeley Lab., Berkeley, CA (US)). *ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Journal;* **30**: No. 6, 34-39(Jun 1988).

The Amoco Corporate Headquarters building, Chicago, Illinois, towers over most of the city. Not only is the building very large, totaling 3.3 million gross sq. ft. but the energy conservation activities and the data available on the building's performance are extensive. More than 10 years of monthly electricity data are available from over 80 utility submeters, measuring the consumption of end uses such as HVAC, lighting and miscellaneous circuits. Gas consumption has been reduced dramatically primarily because of extensive use of heat recovery equipment. Electric peak demands have also been reduced along with electricity consumption. The conversion to VAV has been the most successful electricity conservation technique. Electricity use reductions have occurred during a time of greater office electrification from the addition of equipment like computers and copy machines.

8010 **Techniques for in situ determination of thermal resistance of light weight board insulations.** Kumaran, M.K.; Mitalas, G.P. (Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 1-6 of Heat transfer in buildings and structures. Kuehn, T.H.; Hickox, C.E. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870816—).

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

Four techniques for determining the in situ thermal resistance of rigid board insulation installed in conventional low-sloped roofs are described and compared. All techniques use measured temperature distributions and heat fluxes in the roof systems. The limitations of the techniques are discussed. Test results are presented to allow a comparison of the methods.

## 3202 Transportation

*REFER ALSO TO CITATION(S) 7222, 8625, 8625*

8011 **(CONF-880842—1) Potential benefits of superconductivity to transportation in the United States.** Rote, D.M.; Johnson, L.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003957/JAW.

From First international symposium on superconductivity; Nagoya, Japan (29 Aug 1988).

Research in US transportation applications of superconductors is strongly motivated by a number of potential national benefits. These include the reduction of dependence on petroleum-based fuels, energy savings, substantially reduced air and noise pollution, increased customer convenience, and reduced maintenance costs. Current transportation technology offers little flexibility to switch to alternative fuels, and efforts to achieve the other benefits are confounded by growing congestion at airports and on urban roadways. A program has been undertaken to identify possible applications of the emerging superconducting applications to transportation and to evaluate potential national benefits. The current phase of the program will select the most promising applications for a more detailed subsequent study. Transportation modes being examined include highway and industrial vehicles, as well as rail, sea, air

transport and pipelines. Three strategies are being considered: (1) replacing present components with those employing superconductors, (2) substituting new combinations of components or systems for present systems, and (3) developing completely new technologies. Distinctions are made between low-, medium-, and near-room-temperature superconductors. The most promising applications include magnetically levitated passenger and freight vehicles; replacement of drive systems in locomotives, self-propelled rail cars, and ships; and electric vehicles inductively coupled to electrified roadways.

8012 **(ESC-WR—88-25) Technical principles and backgrounds of the NOVEM-scenario study 'Chances for alternative fuels in the road transport'.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1988. 58p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Technical data are presented of vehicles, development of the mobility, energy expenses and environmental demands, which serve as input parameters for the IEA-MARKAL-model of the Dutch energy economy. The model is used for the scenario studies carried out to find a macro-economical optimum for the total Dutch energy economy. 12 figs., 58 refs., 9 tabs.

8013 **(MU/CRT—551) NETPLAN: a network optimization model for tactical planning in the less-than-truckload motor-carrier industry.** Roy, J.; Delorme, L. (Montreal Univ., Quebec (Canada). Centre de Recherche sur les Transports). 1987. 32p. (MICROLOG—88-03982). Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, P.Q., Canada H3C 3J7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A network optimization model is presented aimed at assisting freight carriers to generate operating strategies which would not only minimize costs but also satisfy service quality criteria. The model integrates many facets of the decision making process at the tactical level of planning, such as the design of the transportation service network and the routing of freight, and describes their relationships and network-wide influence. The paper first gives an outline of how motor carriers actually operate, then describes the network planning problem and briefly reviews existing planning models that can be used at the tactical decision level. The methodological aspect of the approach is presented, followed by a short discussion of results obtained from various scenario analyses. Results taken from experimental studies conducted at two large Canadian carriers are used to show the potential of the model as a network planning tool for ensuring that future demands are satisfied at the right level of service with minimum transportation and freight handling costs. 16 refs., 3 figs., 6 tabs.

8014 **(MU/CRT—1987) Aliages: a system for the assignment of bus routes to garage.** Rousseau, J.-M.; Desilets, M. (Montreal Univ., Quebec (Canada). Centre de Recherche sur les Transports). 1987. 14p. (MICROLOG—88-03983). Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, P.Q., Canada H3C 3J7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of the system described is to assign vehicle trips independently or by lines to the various garages of a transit company in order to minimize both the number of vehicles required and the deadhead costs. The system can also be used to study the optimal location of new garages. A heuristic procedure is proposed for solving this problem because of the variety of operational constraints which must be respected. These constraints include the requirement for trips of a subset of routed to be assigned to a specific garage, to only one garage among a given subset, or to be split amongst no more than two or three garages. Constraints on the minimum and maximum number of buses assigned to a garage for peak and off-peak services are also imposed. The problem and solution methods are discussed in the context of the Montreal Transit Commission, where the system will be implemented. 8 refs., 1 fig.

8015 **(MU/CRT—8704) Design of a multi-vehicles delivery tours satisfying duration constraints.** Langevin, A.; Soumis, F. (Montreal Univ., Quebec (Canada). Centre de Recherche sur les Transports). 1987. 27p. (MICROLOG—88-00026). Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, P.Q., Canada H3C 3J7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The following organization was studied for the letter and parcel pick-up and delivery problem in an urban environment. The day is divided in periods of time in which each vehicle starts from a sorting centre, travels to a very precise area of the region, picks up and delivers letters and parcels, and returns to the depot to have the collected material sorted out for delivery during the following period. The intent of this approach is to have each zone serviced by one vehicle only, in order to facilitate the work of the dispatcher and routing of each vehicle. A method has been developed of partitioning an urban region into zones to be assigned, each one to a specific vehicle, so as to minimize the total number of vehicles used or the total distance travelled by all vehicles. The first part of the method determines the zones and the average number of points to visit. Then, a first refinement of the method takes into account the daily variability of the demand in each zone, whereas a second refinement examines the advantage of allowing some overlapping of zones for the purpose of having an overloaded vehicle relieved by one from an adjacent zone. 17 refs., 11 figs., 2 tabs.

8016 **(MU/HEC—8701) Location-routing problems.** Laporte, G. (Montreal Univ., Quebec (Canada). Ecole des Hautes Etudes Commerciales; Montreal Univ., Quebec (Canada). Centre de Recherche sur les Transports). 1987. 66p. (MICROLOG—88-00022). Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, P.Q., Canada H3C 3J7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Location-routing problems involve simultaneously locating a number of facilities among candidate sites and establishing delivery routes to a set of users in such a way that the total system cost is minimized. This paper presents a survey of such problems. It includes some applications and examples of location-routing problems, a description of the main heuristics that have been developed for such problems, and reviews of various formulations and algorithms used in solving these problems. A more detailed review is given of exact algorithms for the vehicle routing problem, three-index vehicle flow formulations, and two-index vehicle flow formulations and algorithms for symmetrical and non-symmetrical problems. It is concluded that location-routing problem research is a fast-growing area, with most developments occurring over the past few years; however, research is relatively fragmented, often addresses problems which are too specific and contains several voids which have yet to be filled. A number of promising research areas are identified. 137 refs., 3 figs.

8017 (NAL-SP—8, pp 109-114) **Numerical analysis of flow characteristics in laser propulsion system.** Shimada, Toru; Abe, Takashi. (Nissan Motor Co., Ltd., Tokyo, Japan; The Inst. of Space and Astronautical Science, Sagamihara, Japan). Nov 1987. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755746/JAW.

In Special publication of national aerospace laboratory. Transcactions of the 5th aero-computing aerodynamics.

This is one of the report in the 5th. Symposium on the Aeronautical Computation Aerodynamics held by the National Aerospace Laboratory in Nov. 1987. Laser thermal propulsion is a propulsion engine wherein a fuel is heated with laser radiant energy and the energy was expanded by a nozzle into a propulsive power. For the purpose of the system design of the laser-thermal propulsion experiment chamber, a numerical simulation is conducted using a quasi-two dimensional, axisymmetric mathematical model of Glumb and Krier. In order to simplify the local laser intensity calculation, a computational grid of which one coordinate family is made to run along the laser beam is chosen. Calculations are carried out for various values of mass flow rate and laser incident

power. Qualitative understanding is obtained in regard with the dependency of the laser beam absorption rate on these parameters. (7 figs, 2 tabs, 2 refs)

8018 (NAL-SP—8, pp 115-119) **Analsis of flow through pump of large rocket engine.** Yamada, Hitoshi; Watanabe, Yoshiaki. (National Aerospace Laboratory, Chofu, Japan). Nov 1987. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755746/JAW.

In Special publication of national Aerospace laboratory. Transaction of the 5th aero-computing aerodynamics.

A Development of a large launch vehicle (H-II) started in 1985. The first stage of this launch uses a liquid oxygen (LOX)/hydrogen(LH2) engine(LE-7), which generates 1.180 KN in thrust. National Aerospace Laboratory (NAL) takes charge of the LOX turbo pump development till the prototype engine is completed. This paper describes the design method and the experiment, which was carried out using liquid nitrogen and liquid oxygen at the turbopump test facility of the NAL Kakuda Branch. The design method in this paper combines a streamline analysis and a blade-to-blade analysis. The predicted pump head coefficients are in reasonable agreement with the experimental results considering the pump efficiency. Because a large amount of input data are usually necessary to calculate three dimensional flows, a method of calculating blade shapes correctly given only by two blade angles at the impeller inlet and outlet is developed. (7 figs, 1 tab, 5 refs)

8019 (PB—88-249081/XAB) **Status of the nation's local mass transportation: performance and conditions. Report to the congress, June 1988. Biennial report.** (Urban Mass Transportation Administration, Washington, DC (USA)). Jun 1988. 247p. (UMTA-UBP—10-88-1). NTIS, PC A11/MF A01.

See also PB—87-214656.

This document is the third biennial Report of the Secretary of Transportation to the United States Congress on the current performance and condition of the Nation's public mass-transportation systems. It updates the information and recommendations of the previous report and should be of value to the Congress and the Department for developing policy and program requirements to administer the Federal mass-transportation assistance program.

8020 (PB—88-251269/XAB) **Analysis of heavy-duty truck use in urban areas. Final report.** Blower, D.F.; Campbell, K.L. (Michigan Univ., Ann Arbor (USA). Transportation Research Inst.). 30 Jun 1988. 82p. (UMTRI—88-31). NTIS, PC A05/MF A01.

The National Truck Trip Information Survey includes data on mileage by road class, engine characteristics, fuel economy measures, cargo types and weights, and vehicle weights, as well as many other variables that provide a more detailed look at the operation of medium and heavy trucks in urban areas. In the report, the NTTIS sample and survey methodology are discussed. Variables in the study particularly relevant to urban diesel-truck emissions are defined. The bulk of the report is devoted to tables examining the operations of medium and heavy-duty trucks in urban areas. The tables show the structure of the U.S. truck population, the breakdown of truck travel between urban and rural areas by road type, engine horsepower, and gross combination weight.

8021 (PB—89-103675/XAB) **Improving transit productivity and cost-effectiveness: a review of promising strategies. Final report.** (Charles River Associates, Inc., Boston, MA (USA)). Nov 1987. 85p. (CRA—784.30). NTIS, PC A05/MF A01.

This report summarizes lessons learned to date by the transit industry regarding four major types of strategic initiatives aimed to improving productivity or cost-effectiveness of public-transit services. Successful policies to reduce absenteeism are recorded; most combine incentives for improved attendance and disciplinary measures for unsatisfactory performance. Part-time labor is examined as a means to reduce labor costs. Competitive selection of bus service providers--examines the productivity and cost-effectiveness implications of increased service competition. The fourth strategy concerns the better targeting of supply to demand. The final chapter in the report addresses how the suggested actions might be implemented.

8022 (PB—89109094/XAB) **Evaluation of the cost-effectiveness of HOV (high occupancy vehicle) lanes, 1988. Technical report.** Ulberg, C. (Washington State Transportation Center, Pullman (USA)). 20 Jul 1988. 157p. NTIS, PC A08/MF A01.

See also PB—88-161500.

The cost-effectiveness of high-occupancy-vehicle (HOV) lanes was analyzed by comparing the costs and benefits of existing HOV lanes with the hypothetical alternatives of doing nothing or adding a lane for general traffic. Three specific sites in the Seattle area were studied. A life-cycle costing approach was used. The main result of the study was that (for the three locations studied) the construction of HOV lanes was the most cost-effective alternative. The marginal net present value of each of the projects was positive (on the order of $50 to $600 per commuter per year, depending on the specific comparison). The marginal benefit/cost ratio was greater than six for all cases. These findings showed that the three projects under consideration are very cost effective and should remain in place as HOV lanes. The methodology developed for the study was incorporated into an easy-to-use computer program that assesses the cost-effectiveness of the construction of HOV lanes in other locations.

8023 (QU/CIGGT—87-2) **Canadian railway motive power options and development priorities.** English, G.W.; Schwier, C.; Michaud, J.C.; Derlin, M.S.; Boumeester, H.; Young, J.D. (Queen's Univ., Kingston, Ontario (Canada). Canadian Inst. of Guided Ground Transport). 1987. 240p. (MICROLOG—88-03192). Transport Canada, Library and Information Centre, Place de Ville, Tower C, Ottawa, Ont., Canada K1A 0N5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Canada's two major railways face a period of major motive power renewal to the end of this century. This life-cycle cost (LCC) based investigation revealed that, while current-generation locomotives demonstrate a significant incremental value over their predecessors in a buy-new comparison, they do not in a rebuild decision. In express service, higher powers are necessary to make new units more attractive, while in bulk service tractive effort enhancement alone is sufficient. A coordinated program of research is recommended for tractive effort enhancement. New truck development is seen as an area of opportunity for Canadian suppliers, with benefits derived from the higher engine powers and tractive efforts which would be achieved. The conclusion was reached that the medium-speed diesel, although not the best in power/weight ratio, is the best choice from an LCC viewpoint to achieve high engine powers. Further investigation of the value of universality in high performance locomotives is recommended. While ac traction permits both high tractive effort operation, the use of extra powered axles on adjacent coal cars in bulk service is recommended for dc traction; ac traction was not considered to offer sufficient advantage in a retrofit without enhanced performance but may be attractive if it can achieve increased tractive effort. Conceptual design of a steam bottoming cycle retrofit to the Bombardier four-stroke engine is recommended. No alternative fuels were considered sufficiently attractive to warrant conversion at this time. Their development is considered to be a good risk reduction investment, and development of a natural gas prototype locomotive is recommended. 157 refs., 60 figs., 62 tabs.

## 3203 Industry And Agriculture

*REFER ALSO TO CITATION(S) 7371, 7563, 7592, 7593, 7880, 7881, 7882, 7883, 7884, 7885, 8009, 8765, 9165, 9166, 9241*

8024 (AC/R—I-426) **A microprocessor based tractor data acquisition system.** (Agriculture Canada, Ottawa, Ontario. Research Branch). [1983]. 22p. (CE—01993). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In order to aid farmers and encourage efficient use of today's large tractors, it is necessary to develop specific field operation guidelines based on equipment configuration. To this end, Ag-

riculture Canada undertook the development of a microcomputer-based tractor data acquisition system (TDAS). The TDAS was designed to monitor ground speed, all wheel speeds, engine RPM, fuel consumption rate, fuel temperature, air temperature, draft and lower link angle of a large four-wheel drive tractor. The system was based on a Rockwell AIM 65/40 microcomputer, a custom designed digital interface board, and an Analog Devices uMAC 4000 interface board. Operation of the various components of this system performed as designed. Field testing of the unit and software operating system proved satisfactory. 7 refs., 19 figs.

8025 **(AD-A—197648/9/XAB) Technology assessment of selected hazardous-waste minimization-process changes. Final report, 30 September 1986-30 April 1987.** Carpenter, C.J. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA). Engineering and Services Lab.). Mar 1988. 66p. (AFESC/ESL-TR—87-45). NTIS, PC A04/MF A01.

The objective of this study was to technically evaluate selected industrial process changes for applications to Air Logistics Centers for hazardous-waste minimization. Those processes evaluated were as follows: (a) Ion vapor deposition of aluminum as a replacement for cadmium electroplating, (b) Noncyanide strippers to replace cyanide strippers, (c) Plasma spray of chromium to replace chromium electroplating, and (d) Nickel boron as a replacement for chromium electroplating. The study resulted in the recommendation to develop data bases, test plans, pilot studies, and demonstrations of the effectiveness of processes a and b, above, in minimizing hazardous-waste generation. Processes c and d showed minimum potential for hazardous waste minimization, and were not recommended for further study.

8026 **(AD-A—197657/0/XAB) Development of a new process for treatment of paint sludge wastes. Final report, May 1986-December 1987.** Balasco, A.A.; Bodek, I.; Goldman, M.E.; Mazrimas, M.J.; Rossetti, M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 31 Dec 1987. 130p. (ADL—54146). NTIS, PC A07/MF A01.

Original contains colorplates: All DTIC and NTIS reproductions will be in black and white.

This report presents the results of laboratory tests performed on paint-waste samples obtained from the Letterkenny Army Depot (LEAD). The purpose of these tests was to determine if the ash residue from a thermal-treatment process such as combustion would be classified as hazardous according to the Environmental Protection Agency (EPA) Toxicity Characteristic Leaching Procedure (TCLP). In addition, the feasibility of generating a glassified product from the ash which would be classified as non-hazardous was also tested. Finally, tests were also performed to determine if recovery of selected metals from the ash is feasible. The results of the laboratory program suggest that thermal treatment of paint waste under some conditions may be feasible for generation of non-hazardous ash residue. Further experiments on a pilot-scale are recommended, however, to investigate this approach to determine the need for subsequent treatment (e.g., glassification and/or recovery) of the ash product and the actual destruction efficiency of organic components.

8027 **(AD-A—197746/1/XAB) Sodium sulfide/ferrous sulfate treatment of hexavalent chromium and other heavy metals at Tinker, AFB. Final report, 30 September 1986-31 December 1987.** Wikoff, P.M.; Suciu, D.F.; Pryfogle, P.A.; Schutte, W.C.; Carpenter, G.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1988. 96p. NTIS, PC A05/MF A01.

The objective of this research was to validate the use of sodium sulfide and ferrous sulfate in reducing hexavalent chromium and removing heavy metals from electroplating, and industrial waste waters. Jar tests, and dynamic tests, were conducted using distilled water, electroplating rinse waters, and industrial waste waters from Tinker AFB Industrial Waste Treatment Plant. Optimum process parameters were evaluated as well as analysis of the effects of typical contaminants and complexing agents, along with the effects of the process on downstream treatment. The information obtained verified that the sulfide-treatment process will meet discharge-permit requirements while reducing chemical and disposal costs. The results were the basis for continuing to Phase II, Pilot-Scale Study on Actual Industrial Waste waters.

8028 **(AD-A—198868/2/XAB) Design criteria for process waste-water pretreatment facilities. Final report.** Riojas, A.H.; Binovi, R.D. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). May 1988. 126p. (USAFOEHL—88-069EQ0111EIB). NTIS, PC A07/MF A01.

Many industrial waste-water streams can be discharged into Publicly Owned Treatment Works (POTW); however, they must meet prescribed characteristics, and concentrations of specific contaminants must not be exceeded. Waste-water sources on Air Force bases and the corresponding waste-water characteristics are described, applicable discharge limits are reviewed, and typical pretreatment process sequences that would be effective in handling these waste-water classes identified in the report. A description of waste-water treatment processes is included, and design equations and procedures for the processes are provided in the appendixes.

8029 **(CONF-881129—4) Stabilization of a molten-metal/coolant-gas interface by electromagnetic fields.** Hull, J.R.; Wiencek, T. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004269/JAW.

From International symposium on casting near net shape products; Honolulu, HI, USA (13 Nov 1988).

One of the critical issues affecting the cooling of a liquid-metal free surface with a high-velocity gas is the threshold gas velocity for wave formation. In electromagnetic levitation casting, the presence of high-frequency magnetic fields affects the onset and character of waves formed on the interface. A series of experiments was conducted in which nitrogen gas flowed at uniform velocity in a rectangular channel over the surface of a shallow horizontal dish containing liquid tin. The threshold gas velocity was determined when 10-kHz magnetic fields were applied to the surface. The magnetic fields were oriented both parallel and perpendicular to the gas flow. The threshold velocity increased as magnetic field strength increased. Substantial suppression of wave formation was observed with the magnetic field perpendicular to the gas flow, which contradicts previous theoretical predictions. 10 refs., 7 figs.

8030 **(DOE/ID/12495—T31) Electrochemical evaporator for concentrating caustic: A process development unit (PDU) study: Monthly status report, August 1, 1988--August 30, 1988.** (Physical Sciences, Inc., Andover, MA (USA)). 1988. Contract FC07-84ID12495. 29p. (PSI—1034). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003808/JAW.

This paper is concerned with a reactor analysis study of the PDU (Process Development Unit) of the ECC (Electrochemical Caustic Concentrator). The objective of developing the model for the PDU is to help understand the role of the various transport processes and their relative effects on the performance of the ECC. A parametric study on the caustic concentration distribution in the cathode and anode compartments and the corresponding cell voltages were computed. The parameters investigated include: (1) electrode polarization, (2) membrane transport properties, (3) membrane conductivity, (4) electrolyte flow rates, (5) electrolyte temperature, (6) gas flow rates, (7) gas temperature, (8) gas humidity, and (9) current density. 9 refs., 12 figs., 1 tab.

8031 **(EPRI-EM—6148) The foodservice industry: A presentation package with supporting text: Final report.** Hart, G. (Electric Power Research Inst., Palo Alto, CA (USA); Hart, McMurphy and Parks, Inc., Middleburg, VA (USA)). Dec 1988. 135p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004386/JAW.

This document contains material for use by electric utilities in addressing both customer and in-house audiences interested in the foodservice industry. It contains black and white prints of presentation slides and explanatory text for each. A set of 60 35-mm color slides can be ordered separately. Content focuses on an overview of the foodservice industry, its importance as an electric utility customer, and a brief overview of both current technologies

available and planned technical work to meet industry needs. 26 figs.

8032 **(ETSU-N—107) Strategy for R and D leading to improved energy efficiency. New metal forming processes.** Eyre, N.J.; Martin, D.J. (UKAEA Harwell Lab. Energy Technology Div.). Dec 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755466/JAW.

A strategy is presented for a R and D programme on new metal forming processes as a means of improving energy efficiency in the UK metals industries. Thirteen technical areas are identified as being worthy of a five year research programme with the potential for saving an energy equivalent of 0.6 million tons of coal per year. (U.K.).

8033 **(KCP—613-4037) Process characterization of molded low density urethane foam.** Watson, D.R. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Dec 1988. Contract AC04-76DP00613. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004436/JAW.

Low density molded-to-size polyurethane foam parts have has historically low production yields compared with polyurethane products with higher densities. Low density products are more difficult to produce because of the larger volumetric expansion that is required. This additional expansion makes the product more sensitive to processing parameters and more likely to contain surface and internal voids. A designed experiment was formulated to determine how changes in the process variables affect the size and location of internal and surface voids. The part chosen for this study is a low density (0.16 g/cm$^3$) thin-walled (cross section $<$0.35 in.) foam support. The process parameters chosen for this investigation included pour pattern, mold position, mold preheat, mixing speed, R and T component temperatures, and material dispense rate. 12 figs., 3 tabs.

8034 **(NYSERDA—88-9) Industrial heat pump demonstration project.** (New York State Energy Research and Development Authority, Albany (USA); Mechanical Technology, Inc., Latham, NY (USA)). Sep 1988. 55p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89004092/JAW.

This booklet describes an industrial heat pump demonstration project conducted at a plant in Norwich, New York. The project required retrofitting an open-cycle heat pump to a single-effect, recirculating-type evaporator. The heat pump design uses an electrically driven centrifugal compressor to recover the latent heat of the water vapor generated by the evaporator. The compressed vapor is returned to the process, where it displaces the use of boiler steam. The goal was to reduce costs associated with operating the evaporator, which is used for reduction the water content of whey (a liquid by-product from cheese production). The retrofit equipment has now completed more than one year of successful operation. Heat pump coefficient of performance has been measured and is in the range of 14 to 18 under varying process conditions. Generalization of project results indicates that the demonstrated technology achieved attractive economics over a wide range of energy price assumptions, especially when the heat pump is applied to larger processes. 5 refs., 17 figs.

8035 **(NYSERDA—88-10) Use of gas turbine exhaust for the direct drying of food products: Final report.** (New York State Energy Research and Development Authority, Albany (USA); Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1988. 114p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89004091/JAW.

The objective of this program was to evaluate the merits of using natural gas-fired gas turbine exhaust to directly dry food products. A survey of drying practices utilized in the food industry and a detailed review of worldwide regulatory drying practices were completed. An investigation of the economic advantages associated with direct drying was also considered. Four drying scenarios were used as part of the analysis: Dilution - hot turbine exhaust gases were diluted with ambient air to achieve temperatures suitable for food product drying; Indirect Heat Exchanger - gas turbine exhaust was directed through an intermediate heat exchanger to avoid flue-gas contamination of the ambient air; Tri-Generation - exhaust gases from the gas turbine were first directed to a heat recovery boiler and then through the drying system to dry the food product; and Conventional Cogeneration - the most conventional simple cycle gas turbine cogeneration (this scenario served as the baseline for all evaluations). Although the economics associated with direct drying appear attractive, the principal concern of any potential use would be the extraordinarily high NO/sub x/ levels and the potential nitrate and nitrosamine (potential carcinogens and carcinogenic precursors) contamination in food products. 21 refs., 21 figs., 17 tabs.

8036 **(PB—89-100853/XAB) US industrial process heating energy consumption, 1985. Topical report, April 1987-February 1988.** McDermott, H.; Chapman, M.A. (Hagler, Bailly and Co., Washington, DC (USA)). Feb 1988. 220p. NTIS, PC A10/MF A01.

Although natural gas is the industrial sector's preferred energy form, the share of gas relative to total fuel consumption has shown substantial decline in recent years. Total 1985 energy consumption was estimated by fuel type for each of thirteen major industrial process heating categories and numerous subcategories. Industrial-process heating accounts for all direct and indirect heating excluding steam production, cogeneration, and feedstock. These uses represent a wide range of diverse applications including various furnaces, kilns, dryers, and heaters. The amount of gas used for industrial process heating depends upon a number of factors including industry-specific production levels, technology employed, and relative fuel price where fuel substitution is technically feasible. No comprehensive data base is available from which to estimate fuel use for process-heating applications, yet many of these applications are very important to the future of industrial gas use. The study provides a comprehensive overview of industrial process heating energy use in 1985.

8037 **(PB—89-104079/XAB) Evaluation of refractories for aluminum-recycling furnaces. Report of Investigations/1988.** Davis, E.G. (Bureau of Mines, Tuscaloosa, AL (USA). Tuscaloosa Research Center). 1988. 15p. (BM-RI—9178). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 88-600109.

The Bureau of Mines studied the problem of corundum formation on refractory linings in aluminum-recycling furnaces. A laboratory test was developed for evaluating refractories in contact with molten recycled aluminum and identifying the mechanism of corundum formation. A test apparatus was designed and constructed to evaluate the performance of refractory samples. Corundum mechanism formation studies indicated that corundum forms on refractories when there is metal penetration. Once corundum forms, it acts as a wick allowing the molten aluminum to move to the surface where it is oxidized, thus causing further growth of the corundum. Phosphoric acid treatment or a spinel mortar coating prevented corundum formation on the 70- and 90-pct aluminum oxide refractories.

8038 **(PB—89-107338/XAB) Role of energy in irrigated agriculture in Niger.** Kohler, D.F. (CBY Associates, Inc., Washington, DC (USA)). 8 May 1987. 59p. NTIS, PC A04/MF A01.

In Niger, the economic costs of the energy needed to lift water are usually the largest variable costs of irrigation. This report reviews existing systems for supplying electric power and fuel to government-sponsored irrigation perimeters in Niger, with particular attention to the policy framework and the role of parastatals, and makes recommendations for increasing energy efficiency. The author finds that the most economical energy source is generally electricity, either directly from the electrical grid, or, in non-electrified regions, through use of diesel electric-pumping systems. However, in many of Niger's older perimeters, water lifting is performed by energy-inefficient means, namely, by direct-diesel pumps or, worst of all, by gasoline-powered small pumps.

8039 **(PB—89-107346/XAB) Institutional constraints on the transfer of agricultural and complementary resource-conservation technologies appropriate for semi-arid Africa.** Thomson, J.T.; Waldstein, A.S.; Wiese, K. (Associates in Rural Development, Inc., Burlington, VT (USA)). Apr 1987. 104p. NTIS, PC A06/MF A01.

The induced-innovation theory, which holds that appropriate new agricultural technologies will be adopted by farmers and that the necessary supportive institutional changes will follow, is challenged in the study. Addressing institutional issues primarily from the viewpoint of individual farmers as potential adopters, this study uses three low-resource, low-cost, drought-resistant technologies to illustrate its arguments; response farming (i.e., basing crop selection on rainfall predictions); the use of drought-resistant seed strains; and alley cropping. The study (1) examines the economics of existing semi-arid production systems, (2) describes the kinds of institutions needed to test and adapt potentially appropriate technologies; (3) discusses possible political, land tenure, and legal constraints on technology adoption; and (4) analyzes marketing, credit, and infrastructural constraints, with particular reference to food grains, perishables, and industrial crops.

8040 **(SRC—TR/199) Farm fuel requirements. Enerdemo project results.** Rutherford, A.; Gimby, M. (Saskatchewan Research Council, Saskatoon (Canada)). [1988]. 42p. (MICROLOG—88-04339). Saskatchewan Research Council, 30 Campus Dr., Saskatoon, Sask., Canada S7N 0X1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Fuel requirements for common agricultural field operations and cropping practices in Saskatchewan are summarized in this report. The fuel consumption figures given are based on actual fuel measurements taken on farms participating in an energy monitoring project. Consumption was monitored by specially installed meters and by using a suitable recording procedure for assigning fuel consumed to specific operations. Additional noting of acreage covered, operating hours, speed and other factors of interest was done to allow various comparisons to be made. Annual fuel use for crop production is largely determined by tillage and crop rotation practices. Overall fuel consumption, including transportation support of cropping activities, ranges from 10 to 18 litres per seeded acre. Fuel efficient minimum and zero-till systems tend to incur additional fertilizer and/or herbicide input expense, resulting in narrower profit margins than traditional crop-fallow practice. In this respect, a minimum tillage approach, independent of cropping rotations, appears the most favorable. Specific fuel use, developed from fuelling records of individual projects, in general confirm expected benefits from fuel monitoring. Most farm summaries indicate differences in fuel consumption among field operations. Apparent options for reduced fuel consumption tend to group into three categories: selecting the most efficient equipment for the task; modifying operating habits; and reducing the number of field operations. Potential fuel savings range up to 1.5 l/acre for various field operations and average ca 0.2 l/mile for efficient light truck selection. 6 refs., 7 figs., 57 tabs.

8041 **(OA-Trans—2960) Electricity in the dairy industry: 16 EDF case studies, 1981--1983.** (Electricity Council, London (UK). Overseas Relations Branch Translations Service). Aug 1988. Translation source information not available. 91p. NTIS (US Sales Only), PC A05 - OSTI. Order Number DE89004468/JAW.

This report on electricity in the dairy industry contains case studies on: pasteurization; cheeses; fresh products and yoghurts; concentration of dairy products; and drying of dairy products.

## 3206 Municipalities And Community Systems

*REFER ALSO TO CITATION(S) 7537, 7702, 7706, 7736, 7871, 8028, 8099, 9185, 9241, 9313, 9356, 9357*

8042 **(AD-A—197926/9/XAB) Heat recovery at Army Materiel Command (AMC) facilities. Final report.** Pierce, E.T.; Caron, R.N.; Fitzgerald, K.F.; Joncich, D.M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jun 1988. 41p. (CERL-TR-E—88/05). NTIS, PC A03/MF A01.

The objective of this work is to: Identify opportunities for using waste-energy-recovery technologies at AMC sites. Approach: Two AMC sites were selected for study based on a review of documents describing their energy-use patterns. A preliminary list of heat recovery applications suitable for more-detailed analyses was compiled for each site during initial visits. Next, more-comprehensive process-energy studies were conducted at the two plants to determine actual operating conditions of the processes showing most promise for successful heat recovery applications. Cost estimates were developed for all systems to ensure that the economics would be favorable enough to warrant installation; this analysis considered the first cost of all major components, installation, and annual operation and maintenance (O&M) costs.

8043 **(AD-A—199232/0/XAB) Hazardous-waste and waste-water characterization survey, Columbus AFB, Mississippi. Final report, 30 November-16 December 1987.** Slavich, F.E.; Zimmer, A.T.; Tetla, R.A. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jun 1988. 94p. (USAFOEHL—88-076EQ0040FHH). NTIS, PC A05/MF A01.

A waste-water characterization and hazardous-waste survey was conducted to address problems concerning the discharge of industrial wastes to the sanitary sewer system and subsequently to the base waste-water treatment plant. The treatment plant is authorized to discharge to the Tombigbee waterway under the state of Mississippi National Pollutant Discharge Elimination System (NPDES) Permit Program. The results of the hazardous waste survey indicate that the shops wastes are being properly contained, labeled and transported. However, waste oils, solvents and fuels are sent to underground storage tanks that have not been properly leak tested. Most of the oil/water sludge waste is being pumped into an underground holding tank, bldg 1944, for disposal by contractor every three years. This practice is unacceptable. The results of the waste-water survey indicate that both the parts Cleaning Shop, bldg 218, and the Corrosion Control Shop, bldg 262, are discharging substantial amounts of priority pollutants into the sanitary system which are still being found in the treatment plant effluent. High levels of chromium and cadmium were also discharging to the sanitary sewer. The lenient parameters of the State of Mississippi NPDES permit do not cover the priority pollutants that discharge directly into the Tombigbee waterway.

8044 **(CONF-890101—1) Conservation programs can cut load-growth uncertainty for electric utilities.** Hirst, E. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE88016346/JAW.

From Power Engineering Society winter meeting; New York, NY, USA (29 Jan 1989).

Electric utilities face a variety of uncertainties that complicate their long-term planning. Conservation programs that improve efficiency of new residential, commercial, and industrial facilities can both provide cost-effective resources and reduce uncertainties associated with future load growth. Because standards and rebates have different effects on consumer efficiency decisions, standards reduce uncertainty more than do rebates. 8 refs., 5 figs., 3 tabs.

8045 **(DOE/CE/26554—T1) Assessment of district heating and cooling project feasibility in the city of San Jose: Final report, Phase 1.** (San Jose, City of, CA (USA)). 29 Feb 1988. Contract FG01-86CE26554. 72p. NTIS, PC A04/MF A01 - OSTI. Order Number TI89003991/JAW.

This report presents the results of an investigation to identify and evaluate the feasibility of potential district cooling and heating projects in San Jose, California. Three such candidate projects have been identified with the focus on district cooling: the Thunderbird Golf Course Redevelopment site; an 8-block area of downtown San Jose east and north of the new convention center complex; and a block in the Rincon de Los Esteros District bounded by the Guadelupe River, Trimble Road, Component Drive, and North 1st Street. The downtown San Jose and Thunderbird potential projects consider a new central chiller plant in each case, while the Rincon district system considers the utilization of existing facilities' chilled water plants. The study assesses the potential cooling loads, develops in conceptual form the distribution system and central plant designs and implementation plans, and evaluates the system's economics in each case.

8046 **(ENEA-RT-FARE—87-14) Heating systems comparison for a large zone of Turin, Italy.** Fiamberti, A.; Guarino, D.; Di Fazio, T.; Canci, F.; Fasoli, L.; Roccato, M. (ENEA, Rome (Italy)). Mar 1988. 146p. (In Italian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755363/JAW.

The heating systems considered are: - thermal plants for users supplied with fuel oils; - thermal plants for users supplied with methane; - cogeneration-district heating. The comparison within the systems has been made assuming, for reference, heating with fuel oil thermal plants. It concerns only the users that, in the feasibility study, are considered comparable to those within the district heating network. The economic-energetic elements, considered for the comparison,have been: methane consumption, energy savings, investment and cost of usable heat. The evaluations have been realized with market economy criteria and with the same heat service to the users. To avoid outdated results, a sensitivity analysis was performed on the total useful heat cost when varying the investment, fixed expenses and fuel cost. Even if the study refers to a well defined territorial reality, the methodologies adopted could be useful as a starting basis to compare different district heating systems in different urban settings.

8047 **(PB—88-251988/XAB) Local-spin-density study of antiferromagnetism in $La_2CuO_4$ and $YBa_2Cu_3O_6$.** Temmerman, W.M.; Szotek, Z.; Guo, G.Y. (Daresbury Lab. (UK)). Jul 1988. 14p. (DL/SCI/P—596T). NTIS, PC E03/MF E03.

In this letter, the authors present local-spin-density (LSD) calculations for $YBa_2Cu_3O_6$ and $La_2CuO_4$. They found $YBa_2Cu_3O_6$ to be an antiferromagnetic semimetal with a very small or nearly non-existent moment. The value of this moment is not only dependent on the Brillouin zone integration sampling, but is also sensitive to the angular momentum expansion of the Cu and O sites in the $CuO_2$ layers. Expanding (or squeezing) the Wigner-Seitz spheres up to 10% (or down to 9%), or including the breathing mode failed to make $La_2CuO_4$ an antiferromagnetic semiconductor.

8048 **(PB—89-100994/XAB) Recovery and reuse of filter alum and soda alum in a water-treatment plant. Technical report, 1984-1988.** Wang, L.K.; Wu, B.C. (Lenox Inst. for Research, Inc., MA (USA)). 8 Jun 1988. 19p. (LIR—06-88/309). NTIS, PC A03/MF A01.

A Sludge Thickening and Alum Recovery (STAR) system was developed for pollution control and resource recovery. The STAR system is composed of a dissolved air flotation (DAF) unit for sludge thickening, an acid reactor for filter alum recovery, an alkaline reactor for soda alum recovery, and two liquid-solids separators for removal of inert residues from the two reclaimed liquid alums. The report presents the technical data generated from a demonstration project. Both the reclaimed filter alum and reclaimed soda alum are as effective as their virgin equivalents for water purification and phosphate removal.

8049 **(PB—89-101042/XAB) Recycling of filter backwash water and alum sludge for reuse in water treatment plants. Technical report.** Krofta, M.; Wang, L.K. (Lenox Inst. for Research, Inc., MA (USA)). 15 Jun 1988. 41p. (LIR—06-88/305). NTIS, PC A03/MF A01.

The feasibility of recycling backwash water and alum sludge generated from water-purification plants has been investigated. The waste recycle system presented here consists of (a) recycling the filter backwash water to the intake system for reproduction of potable water, (b) dividing the combined sludge into two fractions for alum solubilization, respectively, in an acid reactor and an alkaline reactor, (c) centrifugal filtering the inert silts from alum solutions by two separate water-solid separators for ultimate disposal, and (d) returning the solubilized alums from the two separate water-solid separators in proper proportions for reuse as flocculant(s). The proposed recycle process was designed to provide a cost-effective system for achieving zero water discharge and alum recovery from a water-purification plant. Recommended process-design parameters necessary to achieve the above stated goals were established. Experimental results tend to suggest that practical designs based on the proposed water recycle, sludge thickening, and alum recovery (STAR) system are both technically and economically feasible.

8050 **(PB—89-106264/XAB) Latest improvement on flue-gas treatment technology for municipal-refuse incinerator.** Sakano, H.; Kawashima, T.; Iida, Y.; Uoya, K.; Tomisawa, S. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01).

Included in Mitsubishi Technical Review, Vol. 25, No. 2, 109-114(Jun 1988).

This report presents development procedures and results of operation concerning two kinds of flue-gas treatment systems for municipal-refuse incinerators recently put into practical use by MHI. The one is the Mitsubishi Recycling Flue-Gas-Treatment System which removes HC1, SOx, NOx and dust at the same time with a composite reactor. These systems have been applied to the refuse incineration plants for Ministry of the Environment, Singapore, and for the Environment Center of Iwatsuki City in Japan, respectively. The performance expectations have been fully satisifed, and the plants are operating in good condition.

8051 **(PB—89-110910/XAB) Fladie Ground-water Heat-pump Plant: experiences from the first years of operation.** Andersson, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 63p. (D—9:1988). NTIS, PC E04/MF A01.

The Fladie Ground-water Heat-pump Plant is located next to a small village called Bjarred some 20 kilometers north of Malmo in southernmost Sweden. The system was studied and compared to the electric-boiler system in two steps, both founded by The Swedish Council for Building Research (BFR). The report showed an economic benefit to choose the heatpump system. Based on test drillings, pump tests, etc., favorable conditions also exist in handling the amount of ground water required. The ground-water heat-pump plant was then built as a turnkey contract. It was delivered in springtime 1983 and put into production in the summer the same year.

8052 **(PB—89-110936/XAB) Economic prospects of natural-gas-fired mini-cogeneration plants in Sweden.** Margen, P. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 38p. (D—7:1988). NTIS, PC E03/MF A01.

This report examines the future economics in Sweden of various types of natural-gas-fired cogeneration plants for outputs of 30 kWe to several MWe. Performance and costs are estimated from data on plants of various types in operation in several countries or offered by makers. Size is found to have very little influence on the specific investment cost over the entire size range if one allows for the fact that small plants usually can be accommodated in existing buildings while larger plants mostly require new buildings. Also maintenance costs per kWh are comparatively insensitive to size. Alternative projections are made regarding the sales prices for electricity from such plants at a time when the planned phase out of nuclear power in Sweden is well on its way, and projections of natural gas prices at a time Denmark, Norway and Finland compete for the Swedish natural gas market.

8053 **(PB—89-110951/XAB) Opportunities for group central-heating systems in Canada.** Mattsson, C. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 39p. (D—2:1988). NTIS, PC E03/MF A01.

This report presents the conclusions of an assessment of the market potential for group heating systems in Canada. The focus of the study was on small- and medium-sized systems that link up to 20 to 30 sites to a central heating plant rather than on large municipal-district heating systems. Overall, the market potential for group heating systems in Canada is quite large. Though the attractiveness of many project opportunities has been lessened by the drop in oil and gas prices, many immediate opportunities do exist. Of particular note are opportunities to retrofit central plants in the 5- to 20-MW range, improve efficiency in existing steam distribution systems and develop larger base loads for systems supplied by either biomass or conventional fuels.

8054 **(PB—89-118525/XAB) National survey of solid-waste (municipal) landfill facilities. Draft report (Final).** (Westat, Inc., Rockville, MD (USA). Research Div.). Sep 1988. 74p. NTIS, PC A04/MF A01.

The report describes the methodology and results of a national survey of Subtitle D municipal landfill facilities. A landfill is classified as a municipal landfill if it receives primarily household refuse and commercial waste, and is not a hazardous-waste landfill.

### 3209 Education And Public Relations

*REFER ALSO TO CITATION(S) 7925*

8055 **(DOE/CE/64611—T2) The Energy and School Management seminar and Energy Manager System: Final report.** (Vermont Dept. of Public Service, Montpelier (USA). Conservation and Renewable Energy Unit). 1988. Contract FG01-86CE64611. 135p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89003063/JAW.

The purpose of this program has been to promote long-term energy efficiency in schools by creating a shift in how school administrators perceive the task of managing energy. A one-day seminar, "Energy and School Management," used state-of-the-art management training techniques to deliver the back-to-basics message that energy efficiency is cost-effective, and school administrators were invited to take responsibility for effectively managing energy use and expense in their facilities. Seminar participants were taken through a series of presentations which culminated in the realization that managing energy is their responsibility, and that energy efficiency can be achieved within the realm of their existing financial, management, technical and personnel resources. To support their efforts, seminar participants received "The Energy Manager System," a simple and effective tool which was developed under this program. The Energy Manager System (computerized or manual versions) facilitates energy accounting and operations and maintenance scheduling to optimize building performance.

## 33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

*REFER ALSO TO CITATION(S) 8578*

8056 **(DOE/CE—0240) Tenth annual report to Congress on the Automotive Technology Development Program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Heat Engine Propulsion Div.). Nov 1988. 38p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004977/JAW.

This is the tenth annual report on the progress in implementing the Automotive Propulsion Research and Development Act of 1978 (Title III of Public Law 95-238). The Act provides for an expanded research and development (R&D) effort with respect to advanced automotive propulsion systems technology which would complement and stimulate corresponding efforts by the private sector. Implementation of the Act is the responsibility of the Department of Energy's (DOE) Office of Transportation Systems (OTS). The programmatic goals of OTS are to increase end-use efficiency of highway vehicles and other transportation modes and to substitute abundant domestic fuels for petroleum based fuels. The Lewis Research Center (LERC) of the National Aeronautics and Space Administration (NANSA) is the Technical Project Manager for advanced materials and alternative fuels utilization R&D. The R&D projects in progress address the high-risk areas associated with the development of ceramic components for the gas turbine engine, improvement to the Stirling engine, heavy-duty adiabatic diesel engine technology, advanced materials technology, and alternative fuels utilization technology. 4 figs.

### 3301 Internal Combustion Engines

*REFER ALSO TO CITATION(S) 7551, 8020, 8080, 8089, 8097, 8098*

8057 **(AD-A—197847/7/XAB) Low-temperature pumpability of US Army diesel engine oils. Interim report, July 1982-December 1987.** Frame, E.A.; Montemayor, A.F.; Owens, E.C. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1987. 101p. (BFLRF—229). NTIS, PC A06/MF A01.

Borderline oil-pumpability temperatures (BPT's) were determined for U.S. Army diesel engines by cranking experiments conducted in a cold box. The variables investigated included: four different diesel-engine types; four different oil-viscosity grades; and three different viscosity index improver chemical types. In general, for a given oil, the decreasing order of engine severity (i.e., highest BPT) was: the Continental LDT-465-1C and the Cummins VTA-903T were the most severe, and were approximately equivalent. The GM 6.2L engine was the next least severe with the DDC 6V-53T engine being the overall least severe. The different viscosity index improver chemistries of specially blended test oils included: olefin copolymer (OCP), styrene-isoprene polymer (SI), and polymethacrylate (PMA). The PMA-containing 15W-40 oils had superior low-temperature oil-pumpability performance in each engine in which they were evaluated.

8058 **(AD-A—198325/3/XAB) Literature review of inhibition for vanadate attack.** Bornstein, N.S. (United Technologies Research Center, East Hartford, CT (USA)). Jun 1988. 46p. (UTRC/R—88-917873). NTIS, PC A03/MF A01.

There are economic advantages associated with burning lower-cost residual and certain crude oils, but the corrosive deposits rich in alkali and vanadium promote hot corrosion and negate the savings in fuel costs. It appears possible to attenuate vanadium hot corrosion provided that it is recognized that the problem consists of two related corrosion phenomena. They are the accelerated oxidation of alumina-forming materials by the glass-forming vanadium pentoxide and the accelerated oxidation of these materials by fused alkali vanadates. It is recommended that a research program be initiated aimed at obtaining: 1) a better understanding of the process by which the vanadium in the fuel is transferred to the surface of turbine components in order to assess the feasibility of preventing vanadic deposition, 2) kinetic data and an understanding of the chemistry involved in the formation of the glasses that form on the surface of the advanced alloys and coatings when they are covered with a film of $V_2O_5$ in order to cause devitrification through alloy modification or a fuel additive and 3) kinetic and thermochemical data for the accelerated oxidation of alkali vanadate-coated gas-turbine materials to identify the rate-controlling process or weakest link so that appropriate changes can be made to the alloy or coating through a fuel additive to attenuate the corrosion.

8059 **(AD-A—198690/0/XAB) Atmospheric photochemical modeling of turbine-engine fuels and exhausts. Phase 2. Computer model development. Volume 1. Final report, October 1984-December 1986.** Carter, W.O.; Winer, A.M.; Atkinson, R.; Heffron, S.E.; Poe, M.P. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). May 1988. 260p. NTIS, PC A12/MF A01.

See also Volume 2, AD-A198 691.

A computer model capable of predicting photochemical reactivity of turbine-engine fuel emissions and exhaust emissions from routine AF operations is developed. This Phase II report describes experimental work on engine exhaust components conducted in environmental-chamber facilities. The results indicate that engine exhaust is significantly more reactive than the fuels themselves. The reaction mechanism incorporates new methods for 'lumping' of

complex reactive organic gas (ROG) mixtures when representing them in model simulations. This technical report is divided into two volumes. Volume I explains the computer-model development, while Volume II is the User's Manual.

8060 **(AD-A—198802/1/XAB) Diesel-engine technology update. Final report, January 1983-April 1986.** Kaupert, A.W. (Air Force Reserves Detroit Detachment, Ann Arbor, MI (USA)). Jul 1987. 81p. (—83-021-DET). NTIS, PC A05/MF A01.

This report reviews, assesses, and summarizes the research and development status and progress of advanced diesel engine/vehicle components technology. This report is a logical extension of a previous report, AFWAL-TR-80-2014, which identified vehicular diesel-engine technology applicable to diesel-powered electrical-generator sets. The previous report discussed variable-area turbocharging, variable compression-ratio piston, high-pressure fuel-injection systems, turbocompounding, the adiabatic engine, and the Rankine bottoming cycle. This report adds discussion on alternative fuel, technology forecasting, engine cycle analysis, and cogneration.

8061 (CONF-8611277—, pp 82-91) **Optimizing the formation of the mixture in small two-stroke petrol engines using electronic controls. Pt. 1.** Laimboeck, F. (Steyr-Daimler-Puch A.G., Graz (Austria)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The improvement in fuel measurement and the formation of the mixture is achieved by electronically controlled indirect injection. The fuel jet passes through a hole in the piston on to the piston floor from below. Two of the total of 6 overflow ducts take a rich mixture to the cylinder rear wall in the direction of the sparking plug, which gives good figures for exhaust gas and consumption. The throttle at the inlet adjusts the inlet control period at the same time. 6 patents have been applied for.

8062 (CONF-8611277—, pp 92-107) **Optimizing the formation of the mixture in small two-stroke petrol engines using electronic controls. Pt. 2.** Gaberscik, G. (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

A possibility is shown for achieving electronic engine control for controlling the start of injection, the quantity injected, the ignition timing and additional functions. Using the main parameters of speed, crankshaft position and load and the auxiliary conditions of engine temperature, warming-up time and acceleration, the optimum values for the start of injection, the quantity injected and the ignition timing are determined from the stored characteristics and the engine is thus operated in the most favourable conditions. In addition, the functions of suppression of injection and switching off on thrust can be achieved and possibilities are provided for the control of knocking and lambda and for an outlet adjuster.

8063 (CONF-8611277—, pp 108-122) **Direct fuel injection for two-stroke S.I. engines exhaust emissions abatement.** Nuti, M. (Piaggio S.p.A., Pontedera (Italy)). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

Two new solutions for two-stroke S.I. engine which dramatically improve fuel consumption and reduce exhaust emission, are presented. These solutions are based on a direct fuel injection system avoiding fresh mixture short-circuiting. The first one is implemented on a standard crankcase scavenged two-stroke engine. The second one, a research engine equipped with a seperate scavenging pump, offers better B.M.E.P. performances and eliminates the two-stroke traditional lubrication system.

8064 (CONF-8611277—, pp 136-151) **250 ccm engine with digital ignition and outlet control.** Riedler, W. (KTM Motor-Fahrzeugbau K.G., Mattighofen (Austria)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The use of modern microprocessor technique in ignition systems of racing engines makes it possible to optimize torque and power, particularly in combination with a mechanically controlled outlet control.

8065 (CONF-8611277—, pp 152-168) **New strategies for the optimization of two-stroke engines regarding their power, emission and consumption behaviour.** Landfahrer, K. (AVL-List G.m.b.H., Graz (Austria). Abt. Thermodynamik). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The emission, consumption and torque characteristics of two-stroke engines is greatly affected by load changes. For this reason, a computer program is introduced, which calculates the process in such engines, taking into account the gas dynamics process in the suction exhaust system. The quality of such calculations is demonstrated by a comparison of calculations with the results obtained from the measurements.

8066 (CONF-8611277—, pp 183-190) **Development of cam gear train for super high speed motorcycle engine.** Ishikawa, Mitsuru. (Honda Research and Development Co. Ltd., Asaka (Japan)). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

Gear train for driving a camshaft has not been in common use except for some race oriented engines, although it is known to have a small fluctuation in the camshaft rotation which yields more precise valve timing especially at high speeds as well as low frictional loss, for there is a problem of inacceptable gear noise for production engines. However, for the newly designed engine displacing 250 cc which puts out a specific power output of 180 ps/l with its critical speed of over 17,000 r.p.m., the precise valve timing proves to be essential to fully utilize the pulsating effect of intake pipes and exhaust system. Consequently it has become necessary to develop a cam gear train without fore-mentioned problems. The effect of rigidity of a gear tooth, gear inertia, various dampers, gear back lashes and gear shapes on the mechanical noise of the gear train was examined by the extensive experiments and computer analysis. In turn, the basic modeling of the cam gear train for the computer simulation has become possible and designing of the cam gear train has been highly simplified. As the result, a cam gear train system with less frictional loss, more precise valve timing at high speeds and an adequate level of mechanical noise is successfully developed for the super sports production engines.

8067 (CONF-8611277—, pp 207-212) **Calculation of the temperature distribution and deformation in cylinders using the finite element method.** Eichlseder, H. (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The precise knowledge of the temperature distribution in components is of considerable importance in the design and variation of the cylinders of internal combustion engines. It is therefore useful to calculate the temperature distribution for different variants at the design stage. The possible accuracy of such a calculation, using the finite element method, is demonstrated by a comparison between measured and calculated values. The deformation resulting from a knwon temperature distribution makes a superimposition of calculated deformations from the mechanical stresses possible to determine the total deformation of the cylinder in working conditions, which is difficult to measure.

8068 **(DOE/AL/33183—T9) Multidimensional modeling of convective heat transfer with application to I.C. engines: Progress report.** Jennings, M.J.; Morel, T. (Integral Technologies, Inc., Westmont, IL (USA)). 30 Sep 1988. Contract AC04-86AL33183. 32p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004062/JAW.

The objective of this project is to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. The specific area of research is the representation of heat transfer in detailed multi-dimensional Navier-Stokes models, and modeling of turbulent transport mechanisms. The detailed tasks include a review of relevant prior work. Based on this review, and original work done under this contract, several modeling approaches will be formulated and further studied and tested. The tests will be carried out on flow cases which have relevance to engine flows, and for which reliable experimental data exist. Such data will be sought and identified. The analytical studies will lead to the determination of the best modeling approaches to be used for heat transfer simulation in internal combustion engines. Following that, a detailed study will be carried out of spatial and temporal heat flux distribution in a representative engine. This will be complemented by a parametric study of engine heat transfer dependence on intake flow details, combustion chamber geometry, engine speed and engine load. 4 refs., 20 figs.

8069 **(DOE/CE/50035—T2) Survey results: Tabulated by questions and government/industry responses.** (Engineering and Economics Research, Inc., Vienna, VA (USA)). [1988]. Contract AC01-84CE50035. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003528/JAW.

This report contains the answers given to questions asked in a survey conducted by the Department of Energy's Office of Vehicle and Engine Research and Development. (JF)

8070 **(NP—9770162) Optimization of M 100-vehicle programme. Final report.** Breitsprecher, G. (Daimler-Benz A.G., Stuttgart (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1988. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770162/JAW.

Two vehicle versions were developed in the project entitled 'Optimization of M 100-vehicle programme', that is type 200 with 4-cylinder carburetor engine and type 300 with 6-cylinder fuel-injection engine and closed-loop-system with TWC-catalyst. Both the carburetor engine and the injection engine were developped for two versions: As a bivalent version for methanol fuel and gasoline which will, in the future, be able to use methanol fuel as well as gasoline. These vehicles have an engine concept that is designed for a reasonable compromise between methanol- and gasoline operation. As a monovalent version, optimized for methanol fuel, which utilizes all the advantages of methanol compared to gasoline. These vehicles have got an engine with higher compression ratio (ε11,0) and are optimized for better thermal efficiency and fuel consumption. (orig.) With 31 figs.

8071 **(NP—9770164) Study of a hypothesis for soot formation in a running diesel engine. Final report.** Hiereth, H.; Haak, K.E.; Pelz, N.; Rikeit, H.; Casper, K.; Wenninger, G. (Daimler-Benz A.G., Stuttgart (Germany, F.R.). Zentrale Forschung; Umweltbundesamt, Berlin (Germany, F.R.)). Oct 1984. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770164/JAW.

The study evaluated reaction pathways for soot formation during flame propagation in a Diesel engine. Flamegas samples were taken out of a special Diesel aggregate by a previously developed technique for sampling and analysis with high resolution. The sampling by a gas valve was optimized and checked with regard to stability of the flame front by high speed photography. The use of model fuel enabled the detection of several unsaturated hydrocarbons with low molecular weight in the flamegas, which because of their structure and reactivity can be regarded as soot precursors. The concentration profiles of these potential soot precursors and of soot particulates were bimodal. That bimodal shape was correlated to the respective function of heat release in the cylinder. The results can be summarized to a hypothesis for soot formation, which favours acetylene and its oligomers as key molecules. In the final evaluation of the study recommendations for further research to the soot formation in the Diesel engine are summarized. (orig.) With 58 refs., 3 tabs., 63 figs.

8072 **(NP—9770165) Development and verification of a three-dimensional model for flow and combustion in engines. Final report.** Schaepertoens, H.; Hentschel, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1985. 184p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE89770165/JAW.

Engine research on new combustion systems is increasingly supported by laser techniques and computer capacity. In the course of a previous research project, a four cylinder engine with optical access to the combustion chamber has been built, laser techniques have been developed and a two-dimensional mathematical model has been presented. Meanwhile, three-dimensional computations are feasible, which can compute the physical processes in engine combustion chambers. Such a computer program has been developed, which solves the three-dimensional, time-dependent Navier Stokes equations for compressible turbulent flows including premixed combustion. This model is applied for intake flow, compression flow and homogeneous combustion. The multigrid technique is tested for reduction in computer runtime and colour graphics are used for presenting threedimensional results. Experimental data for initial conditions and verification are gained in a optical accessed engine. Laser-Doppler-Anemometry, Light-Sheet techniques and Laser-Schlieren techniques are applied. (orig.) With 14 refs., 1 tab., 70 figs.

8073 **(NP—9770169) Flame diffusion measurement in compartmentalized combustion spaces of internal combustion engines.** Klueting, M. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 22 Sep 1986. 108p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89770169/JAW.

Knowledge of the processes going on inside an internal combustion engine is important under the aspects of performance and pollutant emissions. The author therefore investigated the three-dimensional flame diffusion in a compartmentalized combustion space. Particular interest was taken in the effect of the mixture leanness on the combustion process and in the effects of combustion space design on the required mixture quality. The measurements were carried out by a multiple-optical-waveguide technique, combined with ion flow measurement into a flexible and universally applicable measuring system. The author discusses the fundamentals of flame research in internal combustion engines, the flame propagation measurements, the effects on the engine process, and the results of the flame measurements are presented. (HWJ).

8074 **(NP—9770171) Development of the DUOTHERM combustion system for d.i.-diesel engines, proposed by ELS-BETT-Konstruktion, as a highly efficient passenger car drive, especially considering the future, rigid emission abatement provisions. Part: 5.0 University of Siegen.** Kleinschmidt, W.; Hofmann, L.; Drescher, E. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Inst. fuer Energietechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1987. 672p. (In German). NTIS (US Sales Only), PC A99/MF A01. Order Number DE89770171/JAW.

The DUOTHERM-combustion system for passenger car di-diesel-engines, proposed by ELSBETT-Konstruktion, Hilpoltstein, and further developed under BMFT-contract TV 8436 B 8 was investigated experimentally and theoretically concerning its heat release, energy balance, performance, emissions and efficiency characteristics. In this connection elaborate test stand measurements, in-cylinder-pressure measurements and heat release calculations were carried out for various ELSBETT-engines and today's production engines for comparison. The results have shown the ELSBETT-combustion system to give a good compromise solution when high performance, low noise and exhaust emissions and good fuel economy are required simultaneously.

8075 **(PB—89-104780/XAB) Development of the Mitsubishi UEC75LSII-type diesel engine. Technical bulletin.** Hirayama, Y.; Ono, S.; Shimoda, K.; Miyano, H.; Oyamada, T. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). Jul 1988. 11p. (MTB—183). NTIS, PC E03/MF A01.

Mitsubishi Heavy Industries, Ltd. developed the first large-bore and superlong-stroke diesel engine, UEC75LSII, which has matched the needs of many customers. In recent years, marine diesel engines have faced severe competition. To meet the present situation, engines not only have to be compact, simple and comparatively lightweight, but also have a high output with high economy and reliability. And they also have new automatic electronic control systems with optimum-engine-setting flexibility in various service conditions of ships. Many methods of investigation of engine performance and reliability were used. Some of those simulation analyses researched and developed at Mitsubishi Heavy Industries, Ltd. were applied. The Finite Element Method which is one of those simulations demonstrated a remarkable improvement in accuracy and in economy of calculation. The report introduces the design concept and excellent engine performance and reliability which were confirmed by the shop test.

8076 **(PB—89-112254/XAB) Aircraft propulsion: leading the way in aviation.** Wittenberg, H. (Technische Hogeschool Delft (Netherlands). Dept. of Aerospace Engineering). Sep 1987. 39p. (LR—532). NTIS, PC E03/MF A01.

Some fundamental aspects of air-breathing propulsion systems are considered with emphasis on fuel economy in relation to the thermal and propulsion efficiency. The state of the art of piston engines in general aviation is surveyed briefly. Next, the application of gas turbines in civil transports at high-subsonic speeds is considered. Trends of future developments with respect to ducted- and unducted (propulsion) concepts are discussed. Furthermore some features of the propulsion of supersonic transports are reviewed, based on the Concorde and future developments. In the final section propulsion concepts for hypervelocity vehicles are reviewed shortly. Throughout the article the leading role of propulsion in aviation is emphasized.

8077 **Photographic study of plasma ignition systems.** Edwards, C.F.; Stewart, H.E.; Oppenheim, A.K. (Univ. of California, Berkeley (USA)). *Society of Automotive Engineers Technical Paper Series;* 1-10(25 Feb 1985). Contract AC03-76SF00098.

A photographic study was conducted using an optical-access compression-expansion machine in order to reveal the mechanism of ignition and flame propagation initiated by plasma igniters. The test included a jet igniter with inert cavity liner (quartz), a jet igniter with reactive cavity liner (paraffin), and a J-gap spark plug. Schlieren cinematographic records were obtained for each condition along with concomitant pressure traces. Basic features of ignition and combustion at lean limit were determined for each igniter. The spark plug permitted lean operation down to an equivalence ratio of 0.7, after which mis-ignition occurred. Jet igniters, these limits were imposed by either extinction of the flame or two slow burning rate, rather than by misfire. 11 references, 5 figures, 13 plates.

## 3302 External Combustion Engines

*REFER ALSO TO CITATION(S) 8069*

8078 **(PB—89-110795/XAB) Evaluation of the public-transportation network: diffusion of innovative transit practices. Final report, January 1983-December 1985.** Harrison, F.D.; Weeks, A.; Walb, C. (Cambridge Systematics, Inc., MA (USA)). Aug 1988. 116p. NTIS, PC A06/MF A01.

This report presents an evaluation of the Public Transportation Network (PTN), a technical-assistance program established by the Urban Mass Transportation Administration in 1983 to help public transportation agencies adopt better ways of managing and operating public transportation services. The PTN featured an innovative approach to technical assistance designed to foster the diffusion of innovative practices through peer-to-peer contacts. The evaluation covers the first 31 months of the PTN, from February 1983 through August 1985. The PTN's development and activities are documented, and the benefits of the program are assessed based on the number and type of programs it played a role in transferring, and on user and non-user perceptions. The report concludes that the program was viewed positively by its users and had a modest impact on both the adoption of innovative practices, option of innovative practices, and the manner in which programs were designed. Major factors that limited the program's effectiveness were organizational inertia, difficulty in getting the attention of local agency decision makers, and the presence of competing priorities within transit agencies.

8079 **Stirling machines: From potential to practicality.** Ross, B. (Energy Sciences Dept., Battelle Pacific Northwest Labs., Richland, WA (US)). *Mechanical Engineering;* **110**: No. 6, 34-43(Jun 1988).

The author describes the principle of operation behind a Stirling machine. Practical Stirling machines, which can be used as heat engines, heat pumps, and refrigerators, share several characteristics, which are described in this article. The author explains the research that is being conducted on Stirling machines. The author says Stirling machines will not replace more common types of engines, but instead will be used in specific applications where the demand for such attributes as multi-fuel capability, low emissions, and long life cannot otherwise be met.

## 3303 Electric-powered Systems

*REFER ALSO TO CITATION(S) 7860, 8011*

## 3307 Emission Control

*REFER ALSO TO CITATION(S) 8064, 8071, 9162, 9162, 9223*

8080 **(CONF-8611277—) 2nd Graz motorcycle conference. Exhaust - noise - new engine concepts. 2. ed.** Eichlseder, H. (comp.). (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). 1986. 232p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The papers read at the 2nd Graz motorcycle conference discussed problems of exhaust and noise emissions in two-wheel vehicles. There are separate records in this database for each of the 15 papers.

8081 (CONF-8611277—, pp 5) **Austrian exhaust gas and noise laws for two-wheeled vehicles.** Hanreich, G. (Bundesministerium fuer Oeffentliche Wirtschaft und Verkehr, Vienna (Austria)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

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According to the 18th Amendment of the Powered Vehicles Order 1967, all mopeds (motorized bicycles) type approved after 1.7.1986, must comply with EEC Regulation No. 47 and all motorcycles type approved after 1.7.1986 must comply with EEC Regulation No. 40 regarding the emission of harmful substances. A step by step regulation to be introduced at times between 1.10.1988 and 1.10.1991 is laid down for the maximum permitted noise level when accelerating past. The limits are 71 db (A) or 69 dB (A) for motorized bicycles, 78 dB (A) or 74 dB (A) for small motorcycles and 80 to 83 dB (A) for motorcycles, depending on the swept volume. Due to catalyst control for cars and the regulations made for lorries, the share of two-wheeled vehicles in the emission of hydrocarbons in traffic will rise to 25 percent by 1990 and to nearly 40% by the year 2000, if there is no restriction of the exhaust gas from this group of vehicles. In the field of noise emission, the handling of the vehicle plays an important part, particularly for mopeds. An improvement in the noise situation can only be expected if the conditions are created for effective supervision, so that there is a guarantee of compliance with the type regulations while actually in traffic.

8082 (CONF-8611277—, pp 6-32) **Results and experience in complying with the legal measures on reducing harmful substance emission from motorcycles and mopeds in Switzerland.** Keusch, L. (Eidgenoessische Materialpruefungs- und Versuchsanstalt fuer Industrie, Bauwesen und Gewerbe, Duebendorf (Switzerland)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The definitive introduction of the USA 83 regulations for private cars with petrol and Diesel engines in Switzerland on October 1st 1987 must increase the share of emission from two-wheelers in the total emission from vehicles. The introduction of EEC Regulations 40 and 47 on October 1st 1983, provided at first more lenient limit of emission from mopeds and motorcycles. The Swiss Parliament's decision on 'Measures to prevent damage to forests' on November 21st 1984 and the Environment Protection Law in force since January 1st 1986 demand that the emission of harmful substances (particularly the emission of hydrocarbons from two-stroke engine vehicles) should be reduced in a further step, according to the technical possibilities and the economic feasibility.

8083 (CONF-8611277—, pp 33-66) **Development of BMW motorcycles regarding exhaust gas and noise.** Pachernegg, S. (Bayerische Motoren Werke A.G. (BMW), Muenchen (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The lecture shows the present legal situation regarding exhaust gas and noise. Results and limits in the direction of exhaust gas and noise are described from the development of the two BMW series of models.

8084 (CONF-8611277—, pp 67-79) **Exhaust gas emission from a two-stroke engine.** Lippitsch, H.H. (Bombardier-Rotax G.m.b.H., Gunskirchen (Austria)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

According to present day ideas, carbon monoxide CO, hydrocarbons HC and nitrogen oxide NO are regarded as harmful substances in the exhaust gas and are therefore limited by law in some countries. After a survey of the regulations in Europe and the USA, the origin of these substances in a two-stroke engine is briefly described. The effect of the type of engine is then shown by results from various engines. It was found that emission can be drastically reduced by new engine designs. The introduction of exhaust gas regulations in Austria has caused the firm of Bombadier-Rotax to intensify their development work in this field. The state of exhaust gas emission of present day mass-produced engines was compared with previous engines at this opportunity.

8085 (CONF-8611277—, pp 123-135) **Reducing the harmful substances from small two-stroke petrol engines.** Laimboeck, F. (Steyr-Daimler-Puch A.G., Graz (Austria)). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The catalytic oxidation of engine exhaust gases in the exhaust was developed to the mass-production stage from several concepts for the reduction of harmful substances in the exhaust gas in 50 cc throttled engines. The lean burn tuning of the engine was necessary for this and by a new configuration of the whole power part (suction filter, cylinder, exhaust etc.), low values of harmful substances could be achieved in the untreated exhaust gas. The torque rose by about 30% and the arrangement of the catalyst in a pipe projecting from the wall into the diffuser is neutral as regards output and gives a short response time of the catalyst.

8086 (CONF-8611277—, pp 213-219) **Present day exhaust gas measurement technique and its application for two-wheelers, in the context of EEC regulations R40 and R47.** Landerl, C. (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

The 18th Amendment to KDV 1967 has been in force in Austria since July 1st 1986. From this time onwards, the law is that in addition to the previously necessary document for the type testing of a new model, it is necessary to provide proof of the emission of gases polluting the air. The complex exhaust gas measurement technique and the course of an exhaust gas test are described, which are carried out in accordance with EEC Regulations 40 and 47.

8087 **(EPS—1988) Vehicle emission test program, Brandon, 1987.** Youmans, T. (Environnement Canada, Ottawa, Ontario. Conservation et Protection). 1988. 34p. (MICROLOG—88-03682). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A vehicle emission test clinic was held in June 1987 in Brandon, Manitoba, to gather information on emission levels of hydrocarbons and carbon monoxide from in-use motor vehicles. Inspections were also carried out to determine the extent of tampering with emission control systems. Emission levels were compared to Environment Canada's suggested exhaust emission test limits, and the effects of tampering on emission levels were assessed. Emissions from the majority of vehicles were found to be within the suggested limits. Tampering resulted in significantly higher concentrations of carbon monoxide and hydrocarbons in vehicle exhaust. 4 refs., 8 figs.

8088 **(NP—9770161) Exhaust gas purification of stationary diesel engines in decentralised energy producing units. Final report.** Schick, K.P.; Strutz, J.; Stahlhut, S.; Blaha, R.; Widdershoven, J.; Pischinger, F.; Lepperhoff, G. (Heraeus (W.C.) G.m.b.H., Hanau (Germany, F.R.); Forschungsgesellschaft fuer Energietechnik und Verbrennungsmotoren m.b.H. (FEV), Aachen (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Angewandte Thermodynamik und Inst. fuer Thermodynamik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1985. 203p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE89770161/JAW.

Emissions of diesel-powered heat pumps up to a heating power of 25 kW were examined and methods and devices for a reduction of the emission level developed. For reduction of the NO/sub x/-level exhaust gas recirculation, for reduction of the CO- and HC-emissions an oxidation-catalyst and for reduction of the particulate emissions a ceramic filter with a catalytic coating that lowers the ignition point of accumulated soot was used. All measures are very dependent of the construction and the operation-mode of the heat-pump because the temperature of the exhaust gas varies widely depending on both. Yearly emissions were calculated and compared to the emissions of an oil-fired boiler. (orig.) With 112 refs., 9 tabs., 72 figs.

8089 **(PB—89-100382/XAB) Genotoxicity of diesel-exhaust particles and vapors collected from engines with and without particulate-trap oxidizers. Final report, 30 May 1986-1 September 1988.** Rasmussen, R.E. (California Univ., Irvine (USA). Dept. of Community and Environmental Medicine). 31 Jul 1988. 103p. NTIS, PC A06/MF A01.

The main objective of the project was to determine the effectiveness of particulate traps in removing the mutagenic substances from diesel exhaust in several types of vehicles and to determine whether varying the composition of diesel fuel affects the mutagenicity of exhaust particles using Ames mutagenicity assays on particle samples obtained from three separate studies. The first study, on two diesel automobiles, showed that the traps generally reduced the mutagenicity of the particle extracts (on a per-mile basis) to the same extent as they reduced the mass of particles emitted. The second study, on a heavy-duty diesel engine, showed that the mutagenicity of particle extracts increased with increasing aromatic content of the fuel but was generally not affected by differences in sulfur content of 90% boiling point of the fuel. The third study, on a bus, showed that an improperly-operating trap increased the mutagenicity of the particle extracts per unit of particle mass.

8090 **(PB—89-101158/XAB) Evaluation of a resistively heated metal-monolith catalytic converter on an M100 neat methanol-fueled vehicle. Technical report.** Blair, D.M.; Piotrowski, G.K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1988. 35p. (EPA/AA/CTAB—88/08). NTIS, PC A03/MF A01.

A prototype metal-monolith catalytic converter, which may be resistively heated, was emission-tested on a M100 neat methanol-fueled 1981 Volkswagen Rabbit. The catalytic converter, when tested as a three-way catalyst without resistive heating, controlled emissions over the Federal test procedure (FTP) to levels previously obtained by ceramic substrate converters coated with noble-metal-catalyst formulations. Resistively heating the catalyst substantially lowered emissions of hydrocarbons (HC) and formaldehyde (HCHO) compared to those from the unheated tests. Also included is the test-procedures, test vehicle specifications, heating-strategy evaluation tests, catalytic-converter specifications, and the modification of the proposed methanol-fueled vehicle.

8091 **(PB—89-104293/XAB) Butadiene measurement technology. Final report, June 1987-February 1988.** Smith, L.R. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1988. 57p. NTIS, PC A04/MF A01.

The program involved the development and validation of a gas-chromatography procedure to measure 1,3-butadiene levels in vehicle exhaust. After development and validation, the procedure was used to measure 1,3-butadiene emissions from each of two gasoline-fueled light-duty test vehicles over duplicate cold-start Federal Test Procedure (FTP) tests. In addition to the 1,3-butadiene measurements, regulated exhaust emissions, other C4 hydrocarbons, and fuel economy measurements were conducted for each FTP test.

8092 **(PB—89-106157/XAB) Ceramic diesel particulate trap.** Kusuda, T.; Yonemura, M.; Shimoda, H. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1988. 9p. NTIS, PC E05.

Text in Japanese; Included in National Technical Report, Vol. 34, No. 4, 35-42(Aug 1988).

A diesel exhaust-gas particulate trap using mullite-fiber ceramics was developed. The application of fiber ceramics to the trap is made possible by the development of a new processing technique of forming, corrugating, and sintering a raw-ceramic sheet obtained from ceramic fiber and cray. The trap has characteristics of not only low-back-pressure but also a filter efficiency of more than 80% thanks to the high porosity and two-dimensional mesh structure of the fiber ceramics. Also, the trap has passed the durability test of repeated regeneration by the incineration of the particulates. The test resulted in no damage, such as cracks, though a high temperature of over 800°C and a local thermal gradient of 20°C/mm were observed. The trap is further undergoing various tests for practical use.

8093 **(PB—89-106801/XAB) Automotive benzene emissions: gas-chromatographic measurements of evaporative and exhaust emissions. Data file.** Belian, T.C.; Seizinger, D.E. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 1988. mag tap. NTIS CP T02.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, DE86-010603.

The tape contains gas-chromatographic results of test fuels and auto exhaust emission measurements obtained in the project. To better define the effect of fuel composition on benzene emissions from current production vehicles, the evaporative and exhaust emissions from five current-model vehicles equipped with representative emission control systems were studied. Fuels consisting of two aromatic levels and four benzene concentrations were tested in the above vehicles. Benzene and regulated emissions were measured in each test segment. Benzene content and the detailed hydrocarbon (HC) compositions of the fuels were also measured.

8094 **(PB—89-109532/XAB) Cost of reducing aromatics and sulfur levels in motor-vehicle fuels. Volume 2. Final report.** Felten, J.R.; McCarthy, K.M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1988. 144p. (ADL—60137). NTIS, PC A07/MF A01.

See also Volume 3, PB—89-109540.

Linear-programming (LP) models were developed for five refineries representative of the California refining industry and validated against historic operation. Process options to reduce gasoline and diesel contaminants were selected and represented in the LP models. Costs were estimated to separately reduce aromatics levels in automotive gasoline, aromatics in diesel, and sulfur in diesel for 1991 and 1995. Cost impacts were scaled up to obtain the overall cost impact in California. Estimates were made of total aromatics and benzene levels in gasoline and of sulfur, aromatics, and cetane levels in diesel. Estimates were made of the impact on refinery emissions, automotive emissions, and automotive performance. The cost to reduce diesel sulfur level to .05% was 6.3 cents/gallon. The cost to reduce diesel aromatics level to 10% was 27.6 cents/gallon. The cost to reduce gasoline aromatics levels by 18% was 7.0 cents/gallon.

8095 **(PB—89-109540/XAB) Cost of reducing aromatics and sulfur levels in motor-vehicle fuels. Volume 3. Appendices. Final report.** Felten, J.R.; McCarthy, K.M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1988. 158p. (ADL—60137). NTIS, PC A08/MF A01.

See also Volume 2, PB—89-109532.

Linear-programming (LP) models were developed for five refineries representative of the California refining industry and validated against historic operation. Process options to reduce gasoline and diesel contaminants were selected and represented in the LP models. Costs were estimated to separately reduce aromatics levels in automotive gasoline, aromatics in diesel, and sulfur in diesel for 1991 and 1995. Cost impacts were scaled up to obtain the overall cost impact in California. Estimates were made of total aromatics and benzene levels in gasoline and of sulfur, aromatics, and cetane levels in diesel. Estimates were made of the impact on refinery emissions, automotive emissions and automotive performance. The cost to reduce diesel sulfur level to .05% was 6.3 cents/gallon. The cost to reduce diesel aromatics level to 10% was 27.6 cents/gallon. The cost to reduce gasoline aromatics levels by 18% was 7.0 cents/gallon.

## 3308 Alternative Fuels

*REFER ALSO TO CITATION(S) 8070*

8096 **(AD-A—199001/9/XAB) Performance of alternate fuels in general aviation aircraft. Final report.** Ferrara, A.M.; Wares, R. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jul 1988. 62p. NTIS, PC A04/MF A01.

This report describes the results of a study that measured the effects of pressure altitude on fuel weathering. In this study, samples of unleaded automobile gasoline were exposed to varying pressure altitudes, and the effects of this exposure on aircraft performance and volatility were measured. The composition of the fuel, aircraft configuration, and the initial temperature of the fuel when transferred to the tank were varied to determine the extent these variables affected the aircraft performance. Experiments conducted demonstrated that the use of 110°F fuel during aircraft certification will provide the greatest margin of safety. In addition, the suitability of methyl-tertiary-butyl ether as an acceptable fuel for use in general aviation aircraft was demonstrated.

8097 **(NP—9770151) Practical investigations on a tractor with a diesel ethanol engine.** Reich, R. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Agrartechnik; Landesanstalt fuer Landwirtschaftliches Maschinen- und Bauwesen, Stuttgart (Germany, F.R.); Ministerium fuer Wirtschaft, Mittelstand und Verkehr des Landes Baden-Wuerttemberg, Stuttgart (Germany, F.R.); Ministerium fuer Ernaehrung, Landwirtschaft, Umwelt und Forsten Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). Nov 1983. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770151/JAW.

The object of the study was the closer investigation of a tractor with a diesel-ethanol engine. After introductory remarks on the engine design, the characteristics of the ethanol are given (supply, use as a fuel). Further investigations carried through were a comparison between this tractor and a diesel tractor of exactly identical design (engine torque curve, performance characteristics, fuel consumption, acceleration), and work relative to the influence of the water content of the ethanol on the engine's performance. A final chapter is about the availability of ethanol in West Germany. All considered, the provision of ethanol from vegetable feedstocks is deemed more difficult than technical problems with the engine. (HWJ).

8098 **(PB—88-247184/XAB) Conversion of methanol-fueled 16-valve, 4-cylinder engine to operation on gaseous $H_2$/CO fuel. Interim report. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1988. 20p. (EPA/AA/CTAB—88/06). NTIS, PC A03/MF A01.

Methanol may be catalytically decomposed to hydrogen and carbon monoxide ($H_2$/CO) gas. This gaseous mixture may be an ideal cold start assist for an M100-fueled engine as well as serving to increase the thermal efficiency of the engine during transient operation. The work described in this interim report concerns the conversion of a 16-valve 4-cylinder light-duty engine to operation on a mixture of $H_2$/CO gaseous fuel. This engine will be evaluated on emission level and lean-limit operation criteria for two fuels: $H_2$/CO gas and M100 neat methanol. Modifications to the engine to accommodate the gaseous fuel are discussed and a description of the specially constructed fueling system is provided. The emissions-measurement system constructed for the test cell is also discussed.

8099 **(PB—89-115257/XAB) Small-engine evaluation and development. Topical report, May 1986-May 1988.** King, S.R. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Engine and Vehicle Research). Jul 1988. 171p. (SWRI—1111T). NTIS, PC A08/MF A01.

The report covers interim results of a project to evaluate the performance, durability, serviceability, and reliability of six small natural gas-fueled engines suitable for cogeneration systems in the 6- to 30-kW electrical output range, and develop improvements to the engines where needed to meet project performance goals. Through extended engine operation at 1800 rpm under full-load conditions the reliability and serviceability of the engines were evaluated. Parameters monitored include lubricating oil consumption and condition, valve recession, and spark-plug erosion. A final teardown inspection after 5,0000 hours of durability allowed the wear of major components to be determined. The potential of small natural gas-fueled engines in cogeneration applications was successfully demonstrated. The major items that limit engine durability and reliability were identified. One engine easily met the 4,000-hour service interval goal and operated for over 4,500 hours with no maintenance. With the correct lubricating oil, oil-change intervals can be greatly increased over currently recommended requirements. Reducing spark-plug erosion and valve recession will be major factors in achieving acceptable reliability and durability for most gas engines.

8100 **(PB—89-116586/XAB) Dual-fuel school bus demonstration. Final report.** (Mueller Associates, Inc., Baltimore, MD (USA)). Oct 1986. 161p. NTIS, PC A08/MF A01.

Three New York State school districts participated in the demonstration project by converting ten buses each to dual-fuel capability. The buses could use both CNG and gasoline or CNG and diesel fuel. Each district also installed a CNG refueling station to serve their buses. School bus fleets were chosen because of their large fuel use, advantageous usage patterns and the benefits that would accure from reduced fuel costs. The report includes both quantitative and qualitative data summarizing bus fuel economy; bus maintenance costs; regulatory problems; safety; training and community acceptance.

8101 **(TIAE—8801) Perspective on new energy. Volume of automotive energy (FY 1987 edition).** (Institute of Applied Energy, Tokyo (Japan)). Mar 1988. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755750/JAW.

This paper describes new energy focusing on the automotive energy. Although fuels alternative to petroleum have been developed since the Oil Crisis, the dependence of automotive fuel on petroleum has been almost unchanged. Synthesis of gasoline from coal has been studied in South Africa and that from natural gas has been made in New Zealand since 1985. The synthesis of gasoline may be technically a measure to counter the future oil crisis, setting aside the economic question. Although natural gas cars are used in oil-producing countries, the mileage is short. In West Germany, gasoline containing 3% of methanol accounts for 70% of the total sales amount. In Brazil, ethanol produced from sugarcane is blended to gasoline. There are problems in the steady production and production cost of methanol, though the technical alternative is promising. Both methanol and natural gas have environmental advantages. An electric automobile is most superior in respect to non-pollution, but it has not spread so much. The aim of worldwide development of new energy is shifting from alternative fuel to petroleum to the environmental measures. (5 figs, 5 tabs, 5 photo, 3 refs.)

# 35 ARMS CONTROL

*REFER ALSO TO CITATION(S) 9121*

## 3501 Policy, Negotiations, And Legislation

8102 **(AD-A—199073/8/XAB) Visit to Shikhany, 1987. Technical report.** (Army Dugway Proving Ground, UT (USA). Technical Analysis and Information Office). 29 Aug 1988. 51p. (DPG/TA—88/025). NTIS, PC A04/MF A01.

In August 1987, the Soviet Union invited participants in the chemical weapons negotiations at the Conference on Disarmament in Geneva to visit the Soviet military chemical facility at Shikhany. The presentation at Shikhany of chemical weapons and of weapon destruction took place on 3 and 4 October 1987. Six members of the US delegation attended. The presentation provided unclassified information on seven chemical agents or agent composites and nineteen weapons for delivery of chemical agents. This report provides a ready reference to the information obtained from the Shikhany visit. Information is included on principal agent types and weapons types. Shikhany is the site of a Soviet military facility and is located in the Volsk district nine hundred kilometers southeast of Moscow, and lies northwest of and adjacent to the Volga river. This report provides descriptions of the chemical munitions displayed for the visitors, the chemical agents for use in the munitions, and Soviet chemical agent demilitarization.

# 36 MATERIALS

8103 **(INIS-SU—57/A) Designing and building. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 101p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; No. 1.

Individual papers in scope are processed separately.

8104 **(RISO-M—2705) Metallurgy department publications and lectures 1987.** Schroeder Pedersen, A.; Bilde-Soerensen, J.B. (Risoe National Lab., Roskilde (Denmark)). Apr 1988. 44p. NTIS (US Sales Only), PC A03/MF A01 - Risoe Library, DK-4000 Roskilde. Order Number DE88755675/JAW.

A presentation (including abstract) of scientific and technical publications and lectures by the staff of the Metallurgy Department during 1987 is given. The list comprises journal papers, conference papers, reports, lectures and poster presentations in the following categories: Publications, Lectures and Poster Presentations.

8105 **An emerging role for the National Laboratories in Materials Research.** Kane, J.S. (Univ. of California, CA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **19A**: No. 6, 1379-1384(Jun 1988).

The mission of the Department of Energy National Laboratories should be expanded to include as an item of high priority collaborative research in support of high technology industry, including the materials industry. There are numerous reasons for doing this. The original missions of the laboratories, other than those of the weapons, laboratories, have been deemphasized or disappeared. The laboratories have superior facilities, often unique, and high quality staffs experienced in the interdisciplinary approach to problem solving. Perhaps most important, domestic industry, especially high technology industry, should have this resource available if it is to meet the challenge of remaining competitive.

8106 **Variability in strength of thermally sprayed coatings.** Ostojic, P.; Berndt, C.C. pp 175-179 of Thermal spray: Advances in coatings technology; Proceedings of the National Thermal Spray Conference, Orlando, FL, Sept. 14-17, 1987. Houck, D.L. Metals Park, OH; ASM International (1988). (CONF-870985—).

From National thermal spray conference; Orlando, FL, USA (14 Sep 1987).

The validity of using the arithmetic mean of five tensile adhesion tests (TATs) as an indicator of coating adhesion or cohesion is considered, and the Weibull analysis method is shown to provide a pertinent parameter for examining the strength variability of thermally sprayed coatings. The significance of data obtained from a standard TAT when it is carried out on a statistically significant sample size is investigated. Using the Weibull modulus and a characteristic stress value for the material, the proposed testing method allows an index of integrity to be established for these coatings which enables interlaboratory tests to be compared. 21 references.

8107 **(N—88-30440) Applications of synchrotron radiation to materials science: diffraction imaging (topography) and microradiography.** Kuriyama, M. (National Bureau of Standards, Washington, DC (USA)). 1988. Transl. into ENGLISH from Advanced Techniques for Microstructure Characterization, Aedermannsdorf, Switzerland, 1988. (NASA-CR—183265; NAS—1.26:183265). 15p. NTIS, PC A03/MF A01.

Synchrotron radiation sources are now available throughout the world. The use of hard X ray radiation from these sources for materials science is described with emphasis on diffraction imaging for material characterization. With the availability of synchrotron radiation, real-time in situ measurements of dynamic microstructural phenomena have been started. This is a new area where traditional application of X rays has been superseded. Examples are chosen from limited areas and are by no means exhaustive. The new emerging information will, no doubt, have great impact on materials science and engineering.

## 3601 Metals And Alloys

*REFER ALSO TO CITATION(S) 7409, 7412, 7441, 7469, 7518, 7529, 7530, 7530, 7532, 7740, 7746, 7746, 7776, 7962, 8029, 8353, 8475, 8476, 8495, 8641, 8880, 9095, 9095, 9105, 10196, 10206, 10209, 10432, 10432, 10433, 10449, 10451, 10453, 10454, 10455, 10456, 10457, 10458, 10459, 10460, 10460, 10461, 10462, 10463, 10464, 10466*

8108 **(AD-A—197124/1/XAB) Coupled s-wave and d-wave states in the heavy-fermion superconductor U(1-x)Th(x)$Be_{13}$. Technical report.** Langner, A.; Sahu, D.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Jun 1988. 22p. (UBUFFALO/DC—88/TR-74). NTIS, PC A03/MF A01.

In the heavy-fermion superconductor U(1-x)Th(x)$Be_{13}$, superconducting states coexist for thorium concentrations O < or = 0.06. Assuming s-wave and d-wave symmetries for these states, a Ginzburg-Landau free-energy expression is derived which couples s- and d-wave states and is rotationally invariant, in contrast to the free-energy expression proposed by Kumar and Wolfle (Phys. Rev. Lett. 59, 1954 (1987)). Discussed in detail are the consequences that follow from the authors free energy relation. In particular, one predicts that in the above system there are two eigenfrequencies associated with the dynamics of phase oscillations (internal Josephson effect) that are characteristic of the s-wave and d-wave states.

8109 **(AD-A—197897/2/XAB) Phase relations in the $Ti_3Al$ + Nb system. Final report, 11 February-15 October 1987.** Kaufman, M.J. (Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering). Jul 1988. 53p. NTIS, PC A04/MF A01.

Arc-melted buttons, melt-spun ribbons and splat-quenched foils of various $(TiNb)_3Al$ alloys (up to 30 at. % Nb) were analyzed in their as-solidified conditions in order to determine the effect of cooling rate on the evolution of non-equilibrium microstructures. For Nb concentrations of 5% and above, the rapidly-quenched structures contained the ordered beta-phase (B2 structure) the volume fraction of which was found to increase significantly with both increasing Nb concentration and increasing quenching rate. The structures of these materials were examined carefully using x-ray diffraction and transmission electron microscopy (TEM) and the results indicated that (1) the size of the B2 domains decreased significantly with increasing quenching rate and decreasing Nb concentration, and (2) the B2 phase always displayed tweed microstructures and diffraction patterns with considerable diffuse intensity

and extra diffraction spots, consistent with previous solid-state investigations.

8110 **(AD-A—198300/6/XAB) Low temperature heat capacities of several high strength materials. Final report.** Ho, J.C.; Dandekar, D.P. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Jul 1988. 14p. (MTL-TR—88-23). NTIS, PC A03/MF A01.

Low-temperature calorimetric measurements were made on three metallurgically prepared high-strength materials: NiAl, W-2 (a heavy tungsten alloy), and Al-Fe-Ce (a lightweight alloy with dispersion strengthening). To fit the heat-capacity data between 3 and 10 K, not only the electronic and lattice contributions having T and T3 dependence, respectively, need to be considered, there is an additional temperature-independent term presumably associated with magnetic clusters. These results provide information on the fundamental characteristics, as well as the heterogeneous nature of the materials not always detectable by standard metallurgical techniques.

8111 **(AERE-M—3537(ed.2)) Underlying and applied oxidation reports published between January 1977 and September 1988.** Moon, D.P. (UKAEA Harwell Lab. Materials Development Div.). Sep 1988. 16p. H.M. Stationery Office, London, price Pound 8.00.

Papers on structural and cladding alloys only and not fuel (uranium and uranium dioxide) are summarised in this compilation. The references are given in roughly chronological order and divided into the following topics: Underlying Oxidation Research: Studies of Diffusion in Oxides and the Oxidation of Metals (45 references), Studies of the Oxidation of Alloys (7 refs), Reactive Element Effect in Inhibiting Oxidation (10 refs), Scale Examination Techniques (15 refs), Laser Raman Spectroscopy of Oxides (8 refs), Computer Simulation of Oxide Grain Boundary Structure and Properties (16 refs), and Applied Studies of the High Temperature Corrosion of Alloys: Microstructure of Oxide Formed on 20%Cr/25%Ni/Nb Stabilized Stainless Steel (20/25/Nb) (3 refs), Effects of Ion Implantation on 20/25/Nb Oxidation (10 refs), Effects of Coatings in Inhibiting 20/25/Nb Oxidation (8 refs), Effects of Reactive Element Alloy Additions in Inhibiting 20/25/Nb Oxidation (1 ref.), Selective Oxidation of 20/25/Nb to Improve Corrosion Behaviour (4 refs), Corrosion and Protection of Structural Steels Other than 20/25/Nb Stainless Steel (12 refs).

8112 **(BARC—1399) Enhancement in capabilities of computer code 'CRACK' and case studies.** Dutta, B.K.; Kakodkar, A.; Maiti, S.K. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.; Indian Inst. of Tech., Bombay). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88704992/JAW.

The computer code 'CRACK' is capable of fracture mechanics analysis of 2-D bodies. The capabilities of this code has now been enhanced by adding few more crack-tip elements and different methods of computing stress intensity factor. A number of case studies are also done to show the variety of problems this code can handle. A few of them are of direct practical interest. Present report details this work and future work planned in this area. (author). 12 figs., 11 refs.

8113 **(CANMET—8602) Fabrication of shielded metal arc weldments. Final report.** Pates, M.J.; Proulx, G. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1986. 124p. (MICROLOG—88-03130). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A series of full fusion butt joints have been welded using steel meeting the Canadan Standards association (CSA) G40.21 - 350 WT specification, but specially processed to meet toughness requirements for Canadian frontier exploration. The joints were welded in the vertical-up postion with a number of different welding electrodes using the shielded metal arc welding (SMAW) process and in thicknesses of 20 mm and 40 mm. A number of test pieces were machines from these joints and sent for testing and eventual analysis of data. In addition, similar test pieces were machined from a number of weldments whose joints had been deposited using the automatic submerged arc welding process (SAW). These test pieces were again forwarded for testing. Finally, a total of 32 tee butt joints were fabricated in both CSA G40.21 - 350 WT and Lloyds Grade 60 in thicknesses ranging from 15 mm through 100 mm for use in a corrosion fatigue evalution program now in progress. These joints were welded in the vertical-up postion, employing techniques similar to those used in equivalent European test programs. 15 figs., 5 tabs.

8114 **(CBPF-NF—081/85) /sup 89/Y NMR study of transferred hyperfine interactions in YFe/sub 2/.** Alves, K.M.B.; Alves, N.; Guimaraes, A.P.; Mackenzie, I.S.; Ross, J.W. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1985. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705021/JAW.

The NMR data on /sup 89/Y in (R/sub x/ Y/sub 1-x/) Fe/sub 2/, where R represents Tb, Dy and Ho, is interpreted in terms of local polarisation of the Fe sublattice by the lanthanide ions.

8115 **(CONF-8806155—3) Role of the densest lattice planes in the stability of crystalline interfaces: A computer simulation study.** Wolf, D.; Phillpot, S. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 40p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003666/JAW.

From Symposium on interfacial phenomena in composites; Newport, RI, USA (1 Jun 1988).

The zero-temperature energies and equilibrium volume expansions of point-defect free grain boundaries (GBs) on the two densest planes of fcc copper, bcc molybdenum and cubic-diamond silicon have been determined, using an Embedded-Atom-Method potential for Cu, a Finnis-Sinclair potential for Mo, and the Stillinger-Weber potential for Si. It is found that in all three structures the energies of the GBs on the second-densest planes are about two to three times higher than of those on the densest planes. For the metals a strong correlation between GB energy and volume expansion at the GB is observed. Owing to its covalent nature of binding such a correlation is not found for Si. It is illustrated that atoms in very close contact (up to about 10% closer than the perfect-crystal nearest-neighbor distance) are mainly responsible for the very large anisotropy in the GB energy. Since the strong repulsive forces between such atoms should be active even in complex interface systems (such as meal-ceramic interfaces or strained-layer superlattices), we suggest that the energetics of even more general interfaces is strongly influenced by Pauli's principle. 34 refs., 5 figs., 8 tabs.

8116 **(DOE/ER/01198—T33) Cascade collapse of heavy-ion irradiated Cu-Ni alloys.** Smalinskas, K.S. (Illinois Univ., Urbana (USA)). 1988. Contract AC02-76ER01198. 45p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002722/JAW.

To evaluate the role of material properties on the probability of a displacement cascade collapsing to a vacancy dislocation loop, the alloy content in Cu-Ni has been varied over the complete composition range. Cu-90wt%Ni, Cu-80wt%Ni, Cu-60wt%Ni, Cu-40wt%Ni, Cu-20wt%Ni, and Cu-10wt%Ni were used in this investigation. The probability of vacancy loop formation in Cu-Ni alloys has been shown to vary with the concentration of Ni. Initially, the inclusion of Ni increases the defect yield but on further addition, the yield decreases to a value lower than that of Cu. The yield starts to decrease when the Ni content exceeds 40%. The maximum and average dislocation loop size also decreases with increasing Ni content. Thus the number of vacancies retained in loops is significantly lower in the high nickel alloys than in pure Cu; a ratio of 13:1 was obtained. There is good agreement between the yields and size distributions in the current data with those reported by Stathopoulos et al. The diverse effects that the addition of impurities have on the probability of forming a dislocation loop from a displacement cascade and the lack of sufficient systematic studies makes it impossible to determine the precise effect. It is likely that more than one mechanism is operative. 31 refs., 14 figs., 3 tabs.

8117 **(DOE/ER/45182—3) Detecting and monitoring crack growth in austenitic and ferritic steels: Progress report for the period 1 December 1986--30 November 1987.** Carpenter, S.H. (Denver Univ., CO (USA). Dept. of Physics). Oct 1987. Contract FG02-85ER45182. 21p. NTIS, PC A03/MF A01 - OSTI. Order Number TI88004204/JAW.

This report provides a brief discussion and presentation of the progress accomplished on the research program "Detecting and Monitoring Crack Growth in Austenitic and Ferritic Steel" during the time period of 1 December 1986 through 30 November 1987. Work to date has been concerned with the use of acoustic emission measurements and signal analysis to detect, monitor and identify crack growth. Significant success has been achieved using acoustic emission parameters to identify crack modes in commercial 304 stainless steel. Various crack modes were obtained using heat treatments and environmental conditions. A study investigating the correlation between acoustic emission and fracture toughness in nodular cast iron is also reported on. Work planned for the rest of the reporting period is also discussed. 10 refs., 9 figs., 1 tab.

8118 **(FhG-IWM-T—4/86) Construction of a test device for testing cracky pipes under internal pressure with superimposed bending load. Technical interim report.** Holzer, N. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.); Fachhochschule Offenburg - Hochschule fuer Technik und Wissenschaft (Germany, F.R.)). Jun 1986. 96p. (In German). Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.).

The project focuses inter alia on the analysis of straight pipes with cracks under different loads. A testing device was designed and constructed which permits to apply to steel pipes in 3 and 4 point bending, via a cylinder operated by servohydraulic mechanism, a bending load in quasi-static and swelling manner at an internal pressure which is variabel over time. In this way, artificial, initial circumferential cracks are to be widened by fatigue under controlled conditions and to be finally stressed to failure. The failure test is conducted under conditions of different system rigidity; to achieve this, the test device has spring elements with a variable characteristic curve between the hydraulic cylinder and the load attack points at the test pipe. Crack widening through fatigue occurs due to the dynamically swelling, attacking load alone, or also due to an internal pressure growing simultaneously. (orig./DG) With 30 figs., 10 refs.

8119 **(FhG-IWM-W—1/87) Experimental studies on inverted notched bar impact bending tests and on the dynamic interactions between multiple cracks. Final report.** Boehme, W. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.); Deutsche Forschungsgemeinschaft, Bonn (Germany, F.R.)). 1987. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756181/JAW.

The dynamic stress behaviour of bending samples with individual cracks and multiple cracks was investigated for different impact bending arrangements. For this purpose not only load and displacement measurements were carried out but also measurements with the shadow-optical caustic method for the experimental determination of the dynamic crack stress. The results of the inverted impact arrangement are discussed with regard to attainable improvements in comparison with the traditional impact arrangement. The results of the dynamic interaction of multiple cracks sometimes showed considerably changed stress conditions in comparison with the statics. Occurring shear stress (mode II shares) can be of essentially greater importance in the dynamic case. A simple test arrangement is suggested, which permits a determination of dynamic material indices with high mode II shares. (orig./HP) With 50 figs., 3 tabs., 44 refs.

8120 **(FhG-IWM-W—3/86) Experimental investigations of notch impact samples with elastic-plastic material characteristics (additional tests).** Beinert, J.; Winkler, S.; Stoeckl, H.; Kalthoff, J.F. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Mar 1986. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756098/JAW.

Experimental data were prepared for the verification and checking of numerical simulation calculations of notch impact tests with elastic-plastic material characteristics. Notch impact tests were done on ISO-V notch impact samples (Charpy V notch samples) made of reactor pressure vessel steel 20 MnMoNi 5 5 (KS 13). Using suitable instrumentation of the sample and the impact hammer, the stress at different positions was measured during the impact process. The test temperature was varied. For purposes of comparison, further measurements were taken with quasi-static load. (orig./HP) With 1 tab., 32 figs., 4 refs.

8121 **(IFUSP-P—698) Electron paramagnetic resonance of hydrogen centers in natural beryl.** Blak, A.R.; Pontuschka, W.M.; Isotani, S. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705090/JAW.

An EPR study of the decay kinetics of atomic hydrogen centers in beryl is reported. The measured spin Hamiltonian parameters are: g = 2.0054 +- 0.0003 and A = (0.930 +- 0.002). 10/sup -17/ erg. The isothermal annealing was measured for temperatures ranging from 60/sup 0/ to 180/sup 0/C.

8122 **(INIS-BR—1357) Liquid phase epitaxy of abrupt junctions in InAs and studies of injection radiative tunneling processes.** Bull, D.J. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). 1977. 47p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705155/JAW.

The p-n junction in a InAs crystal, by liquid phase epitaxy is obtained. The processes of injection and tunneling radiative recombination by emitted radiation from active region of p-n junction for low injection current are studied. (M.C.K.).

8123 **(INIS-BR—1359) Distribution of magnetic field in type II superconductors.** Castro, J.L. de. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). Sep 1986. 92p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705157/JAW.

The magnetie field penetration profile, in type II superconductor, has studied in specially designed cylindrical samples. The samples consist of alternated thick layers ( > 30 μm ) of niobium and copper deposited, by electron-beam evaporation or electrochemical deposition, on cylindric core of either niobium or copper. The magnetization curves, the magnetic susceptibility and the differential susceptibility for small hysteresis loop ( H/sub c1/ < H < H/sub c2/ ) were measured for all the samples between 4. 2 and 9.5 K. These measurements, done with flux pinned and without, show some peculiar descontinuities and inflections which seems to resemble the samples shape. A simple phenonenological extension of Bean's critical state model was applied to these results, giving a resonable qualitative agreement. Also, a more elaborated theoretical model was improve which could give more quantitative fitting.

8124 **(INIS-BR—1360) Forces of vortice trapping and critical current in type II superconductors.** Bormio, C. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). Dec 1985. 140p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705158/JAW.

The vortice-centers interactions of trapping in type II superconductor materials were studied by two theories: thermodynamic (Hampshire-Taylor) and microscopic (Larkin - Ovchinnikov). The study was applied to NbTi with composition of 50% weight of Ti. They are commercial cables containing 361 filaments with final diameter of 0.35 mm for the wire and 9.2 μm foi filaments. The material presents high deformation rate in area and high density of dislocations. These defects actuate as centers of trapping. Variations in themomechanical treatments of superconductor cables modify the interaction mechanisms. The specific mechanism for each treatment type was identified. Measurements of critical current density in function of magnetic field in the range from 1 to 7 Tesla were done, which the usual superconductor parameters as upper critical field and Ginzburg - Landau (Kappa-k) parameter are estimated from literature data. (M.C.K.).

8125 (INIS-mf—11860, pp 15-27) **Investigations of the mechanism of hydrogen diffusion in metals of IVb-group, Ti, Zr, Hf and titanium alloy TiNi/sub 0.5/.** Brauer, E. (Frankfurt Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8126 (INIS-mf—11860, pp 57-67) **Investigation of diffusion and solubility of hydrogen and deuterium in manganese.** Eichenauer, W. (Technische Hochschule Darmstadt (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8127 (INIS-mf—11860, pp 68-74) **Tritium diffusion.** Sicking, G.; Glugla, M. (Essen Univ. (Gesamthochschule) (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8128 (INIS-mf—11860, pp 135-146) **Measuring local hydrogen accumulation in iron and steels.** Wolf, G.K.; Frech, G.; Reiss, G. (Heidelberg Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

Within the framework of this project a measuring method for the determination of the hydrogen content in ferrous metals the nuclear-physical 1H (/sup 15/N,αγ)/sup 12/C reaction was tested and refined. For determining the role of defects and foreign elements as far as possible, a series of iron and steel samples were investigated in the normal state and after electrolytic hydrogen charging. In addition, impurity atoms (He, Ar, Xe; Ca, Al, Ti, Ce, V, Hg, Pb, Ag, Au, Pt, P, O) were doped in thin layers into the iron by ion implantation. By this, it became possible to measure permanent hydrogen enrichment at the impurity atoms by the /sup 15/N-method and to gain statements on the interaction between rapidly diffusing hydrogen with such artificial barriers by means of electrochemical permeation measurements.

8129 (INIS-mf—11860, pp 147-160) **Moessbauer studies of the system Fe-H and Fe-D.** Schreyer, F.; Frech, G.; Wolf, G.K.; Wordel, R.; Wagner, F.E. (Heidelberg Univ. (Germany, F.R.). Physikalisch-Chemisches Inst.; Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

Through the implantation of ions into thin evaporated films, high concentrations of hydrogen and deuterium were introduced into iron at the temperature of liquid nitrogen. The films were tested with the help of Moessbauer spectroscopy. We observe the formation of a new component in the Moessbauer spectra which can be assigned to a concentrated hydride phase or deuteride phase, and which can again decompose into α-iron and H/sub 2/ or D/sub 2/ even at a temperature of roughly 130 K. Moessbauer-type measurements of the hexagonal electrolytic iron hydride manufactured under high pressure indicate that the phase established by implantation constitutes an extremely disordered modification of the high-pressure hydride phase of iron.

8130 (INIS-mf—11860, pp 182-191) **Superconductivity and critical field strengths of palladium-boron-hydrogen alloys.** Brodowsky, H.; Fleischhauer, J. (Kiel Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8131 (INIS-mf—11860, pp 322-337) **Diffusion and permeation of H isotopes through metals; surface effects; effects on the H uptake capacity of metals.** Zuechner, H. (Muenster Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

During the work with Vb metal samples the preparation of the samples was of main interest, i.e. activation for a nearly free hydrogen absorption (removal of the penetration inhibition) and its characterization (with the help of the AES and SIMS technology); for palladium the diffusion, permeation and solubility of hydrogen dependent on the degree of deformation were studied with the help of electrochemical methods with special consideration to the fact that the electrochemical measuring signal (potential) is a surface-sensitive factor; in the investigation of the TiFe-samples it is of interest to characterize the differently activated samples with the help of the surface-analytic methods (SIMS and AES) in order to describe and understand the effect of activation by cyclical charging and discharging.

8132 (INIS-mf—11860, pp 3-14) **Kinetic studies on hydrogen solubility in titanium.** Auer, W. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The investigation aims at determining not only the rate of hydrogen absorption in titanium at different temperatures and hydrogen pressures, but also the rate-controlling partial reaction. For this purposes surface reactions and diffusion processes are suitable in the titanium lattice.

8133 (INIS-mf—11860, pp 401-426) **Effects of H/sub 2/S on hydrogen embrittlement of austenites and dual-phase steels.** Haferkamp, H. (Hannover Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The investigation results regarding the ferritic-austenitic steel 1.4462 agree with existing conceptions of the mechanism of expansion-induced hydrogen embrittlement. This implies that local plastic deformation leads to the formation of fresh, active metallic surfaces which, by dissociative adsoption, increase the supply of atomic hydrogen. Besides the existence of critical expansion rates, it could be proved that cold forming, notch effects and increased partial pressures exerted by hydrogen sulphide favour the tendency to embrittlement. Gas admixtures of O/sub 2/ and CO have an inhibiting effect. Hydrogen sulphide accelerates the crack propagation under dynamic-cyclical strain.

8134 (INIS-mf—11860, pp 453-476) **Influence of a compressed-hydrogen environment on fatigue and crack growth under low-cycle fatigue stress.** Rie, K.T.; Schubert, R. (Technische Univ. Braunschweig (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The results of the investigations on the effect of compressed hydrogen on short-term fatigue behaviour (LCF) may briefly be summarized as follows: In compressed hydrogen, the durability of the materials studied becomes considerably low; instead of a ductile vibration failure, a low-deformation intercrystalline fatigue fracture develops. Hardened materials reveal a higher hydrogen sensitivity than normalized ones. Under the influence of hydrogen, an increased strain amplitude, increased gas pressure or a lower rate of strain may lead to a reduction of durability. Fracture surface analyses, crack propagation measurements and fracture-mechanical investigations confirm these tendencies. Both the expansion intensity DK/sub e/ and a cyclic DJ integral are suitable for the description of crack growth in LCF. They do not reveal any dependence on

the rate and amplitude of strain, but they are sensitive to the changes in material properties due to the influence of hydrogen.

8135 (INIS-SU—56, pp 64-66) **Fabrication of films of Ln-Ni hydride forming compounds.** Alekseev, P.A.; Alekseeva, O.K.; Lazukov, V.N.; Mel'nikov, E.V.; Rusanov, V.D.; Sadikov, I.P.; Sumarokov, V.N.; Chistov, A.G. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

A method of fabrication of LaNi/sub 5/ films with amorphous structure is developed. Using an X-ray analysis the processes of amorphous film structural relaxation are studied. It is shown that crystallization proceeds at 250 deg C, while a thermodynamically equilibrium phase is formed. Some signs of structural rearrangement below and above 250 deg C are observed. 2 refs.; 1 fig.

8136 (INIS-SU—63, pp 3-9) **Computerized simulation of grain boundary atomic structure in bcc metals and grain boundary interaction with point defects.** Bejko, V.S.; Mazilova, T.I.; Orlov, A.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Generalization of researches, where the investigation of atomic structure of large-angle boundaries and twins in bcc-metals is carried out by mathematical simulation methods, is presented. Problems, important for radiation physics and dealing with interaction of intrinsic point defects, their complexes and helium atoms with intergranular boundary, are considered. Investigation of helium atoms interaction with the grain boundary conducted for the first time at the atomic level has shown their primary segregation at grain boundaries during metal irradiation. Influence of grain boundaries atomic structure and their interaction with intrinsic and impurity point defects on materials radiation vulnerability to damage, on grain-boundary slip and destruction processes is discussed.

8137 (INIS-SU—63, pp 94-96) **On point defect absorption by nonequilibrium crack tip.** Savchenko, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Point defects interaction with macroscopic cracks is considered. Vacancies preference absorption, accompanied by crack growth, occurs in the expanded initial crack tip. Expressions for point defects equilibrium concentration near the tip of nonequilibrium initial crack are obtained.

8138 (INIS-SU—63, pp 47-50) **Hydrogen permeability of monocrystalline molybdenum with various substructure.** Babad-Zakhryapin, A.A.; Savvatimova, I.B.; Romodanov, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Hydrogen permeability of cylindrical hollow samples of molybdenum monocrystal with 1x10/sup -3/ m thickness under the conditions of surface bombardment by glow-discharge ions with (300...500)x1.6x10/sup -19/ J energy, and long-term (30-100 hours) exposure at temperatures 1370, 1620 and 1920 K was investigated. It is shown, that hydrogen permeability increase, by two-three times as compared with the initial one, after long-term ion bombardment up to 8x0/sup 26/ m/sup -2/ dose may be connected with dislocation density increase and small-angle boundaries formation.

8139 (INIS-SU—63, pp 51-55) **Crystallization of irradiated metallic glass Fe/sub 82/B/sub 18/.** Naskidashvili, I.A.; Berdzenishvili, T.Sh.; Martkoplishvili, G.S. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Investigation results on irradiation effect on Fe/sub 82/B/sub 18/ metallic glass crystallization and relaxation phenomena in α-Fe and Fe/sub 3/B crystallized phases are presented. It is shown, that at annealing temperature {similar←to}670 K amorphous alloy crystallization becomes predominant. Crystallization activation energy, which constitutes 2.3 eV, is determined. It is shown, that amorphous alloy irradiation in reactor results in crystallization deceleration. It is established, that postcrystallization relaxation of α-Fe precipitate lattice is connected with the departure of excessive boron atoms from its matrix.

8140 (INIS-SU—63, pp 56-61) **X-ray diffraction study of phase transformations in chromium steels irradiated by 40 keV argon ions.** Khmelevskaya, V.S.; Malynkin, V.G.; Solov'ev, S.P.; Ioltukhovskij, A.G.; Leont'eva-Smirnova, M.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Anomalous structural changes, which occur after certain heat treatments and following ion irradiation at 500 degC in EI-993 type ferritic-martensitic steel type EI-993 are found by X-ray structural analysis and microhardness measurements. 40 keV argon ion irradiation of ferritic-martensitic steels after certain heat treatments results in X-ray diffraction pattern essential changing - diffuse scattering occurrence near reflection selective peak which is connected, apparently, with solid solution decomposition. These changes are accompanied by strong radiation hardening. Returning of changes, occuring at irradiation, is observed during post-irradiation annealing.

8141 (INIS-SU—63, pp 67-71) **Mechanism of alloying additions effect on titanium radiation hardening.** Kozhevnikov, O.A.; Fabritsiev, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Experimental research of hardening of titanium alloys with Al, Zi, V additions in the initial state and after neutron irradiation is carried out. Structural investigations of samples in the initial state and after neutron irradiation show, that radiation hardening effect is the combination of radiation defects hardening and phase hardening.

8142 (INIS-SU—63, pp 72-75) **Radiation damage and hardening of molybdenum in 29 MeV alpha particle straggling zone.** Ibragimov, Sh.Sh.; Reutov, V.F.; Loktionov, A.A.; Vagin, S.P. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Technique, allowing to investigate straggling zone (full braking) from high-energy charged particles in detail, is described. Experimental results on investigation of efective structure, created in polycrystalline molybdenum (99.97%) within 29 MeV alpha-particles straggling zone for fluences from 3.8x10/sup 19/ up to 3.7x10/sup 21/ α/m/sup 2/ by methods of microhardness (H/sub μ/, X-ray structural analysis (Δa/a) and transparent electron microscopy (TEM), are presented. It is determined, that for doses from 3.8x10/sup 20/ α/m/sup 2/ and higher, at {similar←to}6 MeV energy, molybdenum "softening" is observed, H/sub μ/ curve within straggling zone is well described by alloyage calculated profile. Δa/a

measurements within straggling zone are well described by damage profile. TEM-investigations have shown the developed defective structure even within molybdenum "softening" range.

8143 (INIS-SU—63, pp 79-91) **Helium desorption out of metals.** Zaluzhnyj, A.G.; Storozhuk, O.M.; Cherednichenko-Alchevskij, M.V. (Moskovskij Fiziko-Tekhnicheskij Inst. (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Analytical review of domestic and foreign researches, dedicated to the investigation of helium behaviour in metals and alloys by methods of thermal desorption spectrometry, is presented. Investigation methods of gas evolution kinetics are considered. Main types of widely used mass-spectrometric facilities, designed for investigation of inert gases thermal desorption from metals, are described. Calculation techniques for gas evolution rate spectra are considered to determine activation energies of processes, responsible for gas desorption from solid body. Mathematical models, describing gas behaviour within solid body lattice, are analyzed. Investigation results for helium-vacancy complexes nucleation and formation within metal lattice obtained by method of thermal desorption spectrometry (TDS) are presented. Analysis of numerous researches on investigation of inert gases desorption (helium, mainly) from metals and alloys, irradiated by low-energy (keV) ions of corresponding gases up to fluences higher, than 10/sup 21/-10/sup 22/ m/sup -2/ is carried out. Influence of such factors as grain boundaries, phase precipitations, dislocation structure etc on gas retention is analyzed.

8144 (INIS-SU—63, pp 62-66) **Structural aspects of weakening of alloy sputtering.** Parshin, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Concept, that alloys surface sputtering rate should depend on structural state peculiarities, is put forward on the basis of the earlier established determining influence of structural transformations at pre-precipitation stage on radiation damage weakening of structural materials. Indeed, at argon ion irradiation of KH12N23TCH austenic precipitation hardening steel in different structural states essential changing of sputtering rate is determined. Sputtering coefficient decrease is bond with the point defects additional forced recombination in stress fields.

8145 (IPPJ—866, pp 34-56) **FFTF-cycle 10 program and future plan.** Kohyama, Akira. (Tokyo Univ. (Japan). Faculty of Engineering). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

This paper provides brief outlines of the FFTF-cycle10 program and future plan in consideration. FFTF-cyclell program is described, in detail, elsewhere in this proceedings.

8146 (IPPJ—866, pp 165-173) **Ferrous materials.** Kohyama, Akira. (Tokyo Univ. (Japan). Faculty of Engineering). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

The primary objective of the sub-group (A) is to enable predictions of material behavior, with special emphasis on ferrous materials, in MFRs to be made from data obtained in other irradiation environments. The major part of this program lies in research works utilizing FFTF/MOTA. Major program goals include: * The development and verification of mechanistic models of damage production and evolution for ferrous materials, * The ability to correlate the mechanical properties of ferrous materials irradiated in different environments, based on mechanistic models, * The ability to extrapolate low- or medium-fluence data to predict high-fluence behavior for ferrous materials.

8147 (IPPJ—866, pp 190-198) **Pure metal and model alloys for fundamental study sub-group project.** Takahashi, Heishichiro. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

Objectives of our research program are to obtain the basic data which are useful for understanding of damage behaviors and to make the modelling of the fundamental damage process for heavily irradiated materials.

8148 (IPPJ—866, pp 236-237) **Effects of minor solute addition on damage microstructures in Fe-Cr-Ni austenitic alloys. Joint research proposal using previously irradiated specimens.** Muroga, T.; Yoshida, N.; Watanabe, H. (Kyushu Univ., Fukuoka (Japan). Research Inst. for Applied Mechanics). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

8149 (IPPJ—866, pp 239-243) **On the dynamic tritium trick.** Matsui, H. (Tohoku Univ., Sendai (Japan)). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

In-reactor decay of tritium may be used to implant helium in vanadium-based alloys as a technique to simulate fusion neutron irradiation. Various technical aspects have been checked and the following scenario appears to be most realistic. a. Load vanadium alloy specimens in a tungsten alloy capsule with a mixture of Li/sup 6/ and Li/sup 7/. Seal the capsule by electron beam welding. b. Irradiate the capsule by thermal neutrons until the tritium concentration in Li becomes the specified value. c. Irradiate the capsule in FFTF/MOTA. The transmutation of Li/sup 6/ is much slower in FFTF. Tritium generation rate is adjusted by choosing a suitable ratio, Li/sup 6//Li/sup 7/, to the tritium leak rate through the capsule wall. d. Unload capsule from MOTA. Tritium in specimens diffuses out to Li during cooling to establish a lower equilibrium concentration in vanadium. e. Open capsules. "Rinse" of specimens with fresh lithium may be effective to reduce tritium level.

8150 (IPPJ—866, pp 183-189) **Refractory metals and alloys, high heat flux materials.** Abe, Katsunori. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

The primary objective of the subgroup (B) is to understand the basic behavior of refractory materials under fusion-related condition. The basic knowledge of the material behavior in high fluence irradiation at high temperature will be obtained by FFTF/MOTA experiment. The research and development of the materials based on refractory metals are very important especially for long term fusion devices, in which first wall materials are exposed to high neutron and heat fluxes at high temperature. The materials to be studied are mainly refractory metals and alloys and their joints and composites with ceramics. Vanadium alloys as low activation materials, molybdenum and tungsten as high heat flux materials, and refractory metal-ceramic joints and composites as advanced materials are typical materials. The organization of the subgroup (B) is shown, The key issues in the subgroup (B) program are the preparation of the materials based on refractory metals, helium production, microstructure evolution and the change of physical property including helium effect, the change of mechanical property by small specimen technique and the correlation of FFTF irradiation results with others. The experiment plan in Cycle 10 program and in future is shown. (Kako, I.).

8151 (IPPJ—866, pp 199-205) **Isotopic tailoring experiments.** Muroga, Takeo. (Kyushu Univ., Fukuoka (Japan). Research Inst. for Applied Mechanics). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

The objectives of the research program to be carried out by this sub-group are to extend their understanding of the effects of transmutative products (especially helium) on damage evolution. In the present program, the following three types of helium implantation experiments are in progress or scheduled: (a) tritium trick for vanadium base alloys, (b) pre-implantation of high energy helium ions and (c) /sup 10/B addition. This sub-group mainly concerns (c) and other possibilities to simulate transmutations using isotope addition techniques. The key issues are: (1) possibility and limitation of /sup 10/B addition as transmutation simulation, (2) helium effects on elementary damage processes, (3) helium effects on component processes, (4) helium effects on high dose damage evolution, (5) effects of metallurgical variables under influence of helium, (6) helium effects on degradation of mechanical properties and (7) charged particle/fission/fission correlation. The /sup 10/B addition technique has several problems as a transmutation simulation technique concerning, for example, homogeneity of melt-in /sup 10/B in specimen and effects of lithium resulting from /sup 10/B reaction with neutrons. Research plans to be carried out using the /sup 10/B addition technique are described. (Nogami, K.).

8152 (IPPJ—866, pp 244-249) **Preliminary proposal for development of an experimental method for investigating helium effects in irradiated vanadium.** Smith, D.L.; Greenwood, L.R.; Loomis, B.A. (Argonne National Lab., IL (USA)). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

This proposal defines a new approach for simulating, during fission reactor irradiation, the simultaneous displacement damage and helium transmutation effects produced in vanadium-base alloys exposed to a fusion neutron spectrum. Vanadium-base alloy specimens are encapsulated with lithium for irradiation in a fast fission reactor. The lithium provides for uniform temperature control, and neutron displacement damage in the vanadium-base alloy is accumulated similar to current procedures. Helium is generated uniformly in the vanadium alloy by the following mechanisms: (1) tritium is generated in lithium by neutron reactions and/or by precharging tritium into the lithium, (2) at elevated temperatures the tritium is highly mobile and diffuses rapidly from lithium into the vanadium alloy attaining predictable near-equilibrium conditions, (3) the tritium in the alloy will decay to helium in the alloy at predictable rates and (4) the helium generation rate in vanadium can be conveniently varied by plus or minus an order of magnitude from the calculated target rate by varying the /sup 6/Li enrichment and/or the precharged tritium concentration. Most of the data base required to verify this method is available. Flexibility in several inherent parameters is sufficient to provide variations in He/dpa ratios of interest. (Nogami, K.).

8153 (N—88-29874) **Iridium-coated rhenium thrusters by CVD.** Harding, J.T.; Kazaroff, J.M.; Appel, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 12p. (NASA-TM—101309; E—4304; NAS—1.15:101309; CONF-8809211—). NTIS, PC A03/MF A01.

From 2. international conference on surface modification technologies; Chicago, IL, USA (25 Sep 1988).

Operation of spacecraft thrusters at increased temperature reduces propellant requirements. Inasmuch as propellant comprises the bulk of a satellite's mass, even a small percentage reduction makes possible a significant enhancement of the mission in terms of increased payload. Because of its excellent high temperature strength, rhenium is often the structural material of choice. It can be fabricated into free-standing shapes by chemical vapor deposition (CVD) onto an expendable mandrel. What rhenium lacks is oxidation resistance, but this can be provided by a coating of iridium, also by CVD. This paper describes the process used by Ultramet to fabricate 22-N (5-lbf) and, more recently, 445-N (100-lbf) Ir/Re thrusters; characterizes the CVD-deposited materials; and summarizes the materials effects of firing these thrusters. Optimal propellant mixture ratios can be employed because the materials withstand an oxidizing environment up to the meltimg temperature of iridium, 2400 C (4350 F).

8154 (N—88-30164) **Experimental study of biaxial yield in modified 9Cr-1Mo steel at room temperature.** Ellis, J.R. (Akron Univ., OH (USA)). Nov 1985. 16p. (NASA-CR—175012; E—2776; NAS—1.26:175012; CONF-850809—). NTIS, PC A03/MF A01.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Described are two biaxial experiments which investigated yield, hardening, and flow behavior in modified 9Cr-1Mo steel at room temperature. The aim of these experiments was to determine whether the procedures recommended in NE Standard F9-5T for inelastic design analysis are applicable for this material in normalized and tempered condition. The first experiment investigated small offset yield behavior subsequent to radial preloads (sq rt of 3 sub sigma 12 = sub sigma 11) in tension-torsion stress space. The second experiment investigated yield behavior subsequent to nonradial preloads and also the time-dependent flow occurring during 0.5 hour periods at constant stress. The results of these experiments were qualitatively similar to those obtained earlier for types 304 and 316 stainless steel. Specifically, the von Mises yield criterion was found to provide a reasonable approximation of initial yield behavior. Although the subsequent yield surfaces suffered considerable distortion from their near-circular form after both radial and nonradial preloads, the hardening behavior was to the first order kinematic in nature. The strain-time data obtained during the 0.5 hr hold periods showed characteristics typical of creep curves. As in the case of earlier experiments, the high initial flow rates diminished more rapidly than would be estimated from elevated temperature data.

8155 (PB—88-251186/XAB) **Release and migration of activation products of corrosion-resistant metal specimens in marine sediments. Technical report.** Ball, L.A.; Sayles, F.L. (Woods Hole Oceanographic Institution, MA (USA)). Aug 1988. 44p. (WHOI—88-31). NTIS, PC A03/MF A01.

The experiment was designed to measure the release and migration of the neutron-activated radionuclides. Ni-63, Co-60, and Fe-55, from two types of corrosion-resistant alloys, Incone1-600 and SS-347 into marine sediments. On 11 August 1982, six 50-cm-long probes were deployed at Deep Ocean Site 2 (DOS-2). Each probe held 5 metal specimens such that each specimen would be exposed to sediment at depths of approximately 3, 7, 15, 25, and 40 cm. Three probes held Incone1-600 specimens and three held SS-347. On July 17, 1983, one probe of each type of metal (probes 3 and 5) was recovered. The extrusion and subsectioning procedure as well as the analytical methods and results from these cores were described in detail in the previous report. The integrated release rates for the three nuclides fell between 0.02-13 nCi/sq cm/yr for Incone1-600 and 0.007 to 0.36 nCi/sq cm/yr for SS-347. Estimated diffusion coefficients were between $10^{-8}$ to $10^{-9}$ sq cm/sec for the three nuclides.

8156 (PB—89-111561/XAB) **Recent picture and outlook of the use of rare earth metals in steelmaking in China. Technical report.** Cao, X.; Feng, Y. (Baotou Inst. of Metals Research (China)). 1987. 18p. NTIS, PC E03/MF A01.

A general review of the use of rare earth metals (REM) in steelmaking in China for the past 20 years is presented. Through a large amount of research work and industrial trials, steels containing RE have been produced. Practice shows that REM additives improve transverse impact toughness and ductility of low-carbon and low-alloy steels, improve hot workability of high-alloy steel and increase service life of resistance-alloy wires, improve low-temperature impact toughness and temper brittleness of structural alloy steels, and prolong fatigue life of steel products. REM also find application in improving as-cast structure and decreasing cracking tendency of steel castings and contincast slabs. The problems arising from the method for adding REM in steelmaking was once the bottleneck of the development of the use of REM in steel industry.

The mechanism of the effects of RE on steel properties is also described. Finally, the outlook for the use of REM in steel industry is also described.

8157 **(PB—89112668/XAB) Determination of the alloying amount of Ce and its distribution in steels by radioactive tracer method. Technical report.** Han, Q.; Wu, W.; Fang, K.; Huo, C.; Zhou, X. (University of Iron and Steel Technology, Beijing, BJ (China)). 1987. 17p. NTIS, PC E03/MF A01.

Steel samples containing cerium sulfide and cerium oxide traced by $^{14}Ce$ were electrolyzed to detect the stability of cerium sulfide and cerium oxide under the chosen conditions of electrolysis. The results of the authors experiments show that the decomposed amount of cerium sulfide and cerium oxide during electrolysis is extremely small, the former less or equal 0.4%, the latter less or equal 0.027%. The measurements of the cerium content in the 5 kinds of steel show: if the original content of S and O in steel before the addition of Ce is high, there is almost no dissolved cerium in the low Ce content steels. The alloying amount of Ce increases with the increase in Ce content in steels. Experimental results show that the method used by former researchers for determining the alloying amount of the rare earths by the difference between the total rare earth amount in the sample and the rare earth amount in the inclusions is unreliable owing to the segregation of rare earth inclusions in the steel. Microautoradiographs show that the inclusions containing cerium are more concentrated in pearlite of the as-cast 25 MnTiB steel. Ce is distributed in a strip shape within the grains of as-cast Fe Cr Al alloy. The concentration of Ce in the grain boundaries was not observed by the autoradiography.

8158 **(SAND—88-0530C) Diagnostics of a low-pressure plasma spray deposition system.** Weissman, S.H.; Smith, M.F.; Chambers, W.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 30p. (CONF-881026—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003143/JAW.

From National thermal spray conference; Cincinnati, OH, USA (24 Oct 1988).

The effects of changes in arc gas composition for low-pressure plasma spray (LPPS) deposition of copper have been investigated by measuring plasma emission spectra for Ar/He and $Ar/H_2$ plasmas. A Boltzmann slope method was used to calculate temperatures from Ar atomic emission lines, and the relative intensities of Cu and H emission lines were compared. Boltzmann equilibrium distributions were not observed in Ar emission spectra close to the spray gun, but equilibrium distributions for excited Ar states were observed at longer distances with a low spray chamber pressure. Calculated temperatures, which ranged from 5250 to 8450 K, are representative of the argon electronic state population distribution. Relationships among the computed argon excitation temperatures and temperatures of other plasma species will require further investigation, since it has not been clearly established whether local thermodynamic equilibrium (LTE) or partial LTE exists under the conditions of our measurements. Samples of copper spray deposited with Ar/He vs. $Ar/H_2$ were also analyzed to compare oxygen content, microhardness, and porosity. The results demonstrate that a relatively small (4 vol.%) addition of $H_2$ auxiliary gas was more effective in reducing the oxygen content and hardness of LPPS deposited copper than a comparatively larger amount (24 vol.%) of He. However, there was no significant difference in coating porosity with these two auxiliary gases. 12 refs., 4 figs., 1 tab.

8159 **(SAND—88-1534C) Tribology of amorphous alloys formed with ion beams.** Follstaedt, D.M.; Knapp, J.A.; Pope, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 23p. (CONF-881155—9). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003274/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The changes in friction and wear properties (i.e., tribology) of steels due to thin surface alloys formed by ions beams are surveyed, and considered in light of their microstructure. Amorphous alloys containing both Ti and C are found to give superior performance in comparison to alloys with N, B, C, P or Ti. All the amorphous layers reduce friction, but the duration of benefits and wear resistance at high loads vary with composition. By examining similar amorphous alloys with Ti alone or C alone, the critical roles played by each in resisting wear are demonstrated. Amorphous alloys with Ti and C appear to be quite hard. 74 refs., 11 figs.

8160 **(SAND—88-1564C) Deuterium interactions with ion-implanted oxygen in Cu and Au.** Myers, S.M.; Swansiger, W.A.; Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-881155—8). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003275/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The interactions of deuterium (D) with oxygen in Cu and Au were examined using ion implantation, nuclear-reaction analysis, and transmission electron microscopy. In Cu, the reduction of $Cu_2O$ precipitates by D to produce $D_2O$ was shown to occur readily down to room temperature at a rate limited by the transport of D to the oxides. The reverse process of $D_2O$ dissociation was characterized for the first time below the temperature range of steam blistering. The evolution of the $Cu(D)-Cu_2O-D_2O$ system was shown to be predicted by a newly extended transport formalism encompassing phase changes, trapping, diffusion, and surface release. In Au, buried O sinks were used to measure the permeability of D at 573 and 373 K, thereby extending the range of measured permeabilities downward by about six orders or magnitude. 14 refs., 4 figs., 1 tab.

8161 **(SKB-TR—88-09) Kinetics of pitting corrosion of carbon steel. Progress report to June 1987.** Marsh, G.P.; Taylor, K.J.; Sooi, Z. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Feb 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756179/JAW.

This report describes progress between April 1986 and May 1987 in a programme studying the kinetics of pitting corrosion in carbon steel containers for the disposal of high level nuclear waste in a granitic repository. Experimental studies are being undertaken with the following objectives: (a) To improve the validation of a mathematical model for the propagation of pitting corrosion. (b) To develop an improved statistical method for analysing experimental pit growth data to take account of the difference in area of laboratory specimens and full size waste containers. (c) To estimate the maximum period during which pitting attack is feasible under repository conditions by calculating the time during which the diffusion of oxygen to the containers will be sufficient to maintain carbon steel in its passive state. Work in the first 14 months of the project has concentrated on (b) and to a lesser extent on (c).

8162 (VTT-SYMP—87, pp 121-133) **Canister materials corrosion experiment.** Aaltonen, P.; Aho-Mantila, I.; Haenninen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

Environmental effects on the fracture of pure OFHC-copper have been studied by using a slow strain rate testing (SSRT) method in simulated ground water conditions and in nitrite solutions. Tests at room temperature produced ductile dimpled fracture and the elongation to fracture was about 35%. However, tests at 80 deg C performed in distilled water and in glycerin produced intergranular ductile fracture and the elongation to fracture was reduced to 24%. The intergranular ductile fracture of pure OFHC-copper at 80 deg C was influenced by the chemical composition of the environment. Additions of chlorides and sulfates to the ground water environment further decreased the elongation to fracture obtained in SSRT-tests to 14%. These results are interpreted by environment sensitive creep phenomenon. Tests were also performed in nitrite environment (0.3 M NaNO/sub 2/) where transgranular stress corrosion cracking was produced. The tests were conducted

also at various potentials in order to determine the threshold potential for cracking.

8163 **Strong traps for deuterium in krypton-implanted nickel.** Frank, R.C.; Pearce, J.L.; Watson, E.T.; Rehn, L.E.; Baldo, P. (Physics Department, Augustana College, Rock Island, Illinois 61201). *Journal of Applied Physics;* **65**: No. 3, 1023-1029(1 Feb 1989).

Experiments were carried out to investigate strong traps (binding enthalpies>0.50 eV) for deuterium that were found earlier when pure nickel was implanted with argon and krypton at temperatures ≦500 °C. In one experiment, three different areas of a nickel specimen were implanted with a fluence of 2 x $10^{16}$ $cm^{-2}$ krypton at 600, 700, and 800 °C; a second experiment involved implanting krypton at three different fluences (2, 6, and 20 x $10^{15}$ $cm^{-2}$) in nickel at 500 °C. Retained deuterium was monitored during subsequent isochronal anneals using nuclear reaction analysis. In a third experiment, depth profiles for both implanted krypton and trapped deuterium were determined simultaneously using secondary ion mass spectrometry. Traps for deuterium in krypton-implanted nickel were found with binding enthalpies ranging from 0.5 to 1.1 eV. At implantation temperatures <500 °C, the traps are in the same location as the krypton atoms. At implantation temperatures >700 °C, the traps are found where the krypton was originally implanted in spite of the fact that a significant fraction of the krypton apparently escapes through the surface during the implantation process. The observed fluence and temperature dependence indicate that the traps with binding enthalpies between 0.5 and 1.1 eV are associated with the surfaces of cavities formed during the implantation.

8164 **Resistivity and microstructure of heavily drawn Cu-Nb alloys.** Verhoeven, J.D.; Downing, H.L.; Chumbley, L.S.; Gibson, E.D. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **65**: No. 3, 1293-1301(1 Feb 1989).

A combined resistivity transmission electron microscopy (TEM) study has been done on heavily drawn Cu-20 vol % Nb alloys (so-called in situ alloys). The results show that electron scattering at Cu-Nb interfaces makes the major contribution to resistivity in heavily drawn wire. The dislocation contribution is small and constant at deformation strains greater than around 4, apparently as a result of dynamic recovery/recrystallization of the Cu matrix which occurs during room-temperature drawing. Results of this study and other recent TEM dislocation studies indicate that the dislocation density in heavily drawn Cu-20 vol % Nb material does not exceed $10^{11}$ $cm^{-2}$. It is demonstrated here that the $10^{13}$- $cm^{-2}$ dislocation density predicted by the resistivity study of Karasek and Bevk [J. Appl. Phys. 52, 1370 (1981)] is high because the interface scattering contribution is more strongly reduced by coarsening than they assumed. It is shown that resistivity measurements provide a means of evaluating an average Cu channel diameter in the aligned composite alloys formed at large deformation strains.

8165 **Formation of a nearly pure aluminum layer in beryllium using ion implantation.** Brown, D.W.; Musket, R.G.; Munir, Z.A. (University of California, Davis, California 95616). *Applied Physics Letters;* **54**: No. 4, 326-328(23 Jan 1989).

A nearly pure subsurface layer of an implanted element was created using aluminum implantation into beryllium. In particular, post-implant annealing of polycrystalline beryllium samples implanted with 200 keV aluminum caused a dramatic increase in the peak aluminum concentration as determined by Rutherford backscattering. The effect was observed for all three doses studied: 0.46, 1.1, and 4.6 x 10/sup 18/ Al/$cm^2$ . For the 1.1 x 10/sup 18/ Al/$cm^2$ case, cross-sectional transmission electron microscopy of the annealed sample revealed a distinct subsurface layer with the structure of crystalline aluminum. Auger sputter profiles of individual grains showed the layer purity to be as high as 98 at. % aluminum. However, there were indications that the layer formation and/or purity were grain dependent.

8166 **Application of Onsager's reciprocity relations to interface motion during phase transformations.** Kaplan, T.; Aziz, M.J.; Gray, L.J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Journal of Chemical Physics;* **90**: No. 2, 1133-1140(15 Jan 1989).

A number of theories have been developed for the kinetics of steady-state interface motion during a phase transformation. One requirement of such theories is that they satisfy Onsager's reciprocity relations for coupled irreversible processes. We show how to apply Onsager's relations to a phase transformation at a moving planar interface in a two-component system. The appropriate pairs of thermodynamic forces and conjugate fluxes are determined and used to test two proposed theories for interface motion during solidification of binary alloys. It is shown that the continuous growth model "with solute drag" of Aziz and Kaplan is inconsistent with Onsager's relations, but the continuous growth model "without solute drag" is consistent with Onsager's relations.

8167 **Fluorescence extended x-ray absorption fine structure study of silicon in neodymium iron boron rare-earth magnets.** Brennan, S.; Bienenstock, A.; Keem, J.E. (Stanford Synchrotron Radiation Laboratory, Stanford, California 94305). *Journal of Applied Physics;* **65**: No. 2, 697-703(15 Jan 1989).

Rare-earth transition-metal magnetic materials consisting of $Nd_2Fe_{14}B$ with small amounts of Si, produced by melt-spinning, have been studied using fluorescence extended x-ray absorption fine structure. A windowless Si(Li) solid-state detector was used to collect the Si fluorescence. These polycrystalline samples are unusual in that they are magnetically isotropic, yet have a very high remanent magnetization. The silicon atom is bonded to a single shell of iron atoms at a distance of 2.46 +- 0.05 A. The results strongly suggest that (1) Si does not segregate at the grain boundaries or cluster with other Si atoms, and that (2) Si replaces the iron atom at the "c" site of the standard $Nd_2Fe_{14}B$ structural model within the grains.

8168 **Deuterium interactions in oxygen-implanted copper.** Myers, S.M.; Follstaedt, D.M. (Sandia National Laboratories, Division 1112, Albuquerque, New Mexico 87185-5800). *Journal of Applied Physics;* **65**: No. 1, 311-321(1 Jan 1989).

The interaction of deuterium (D) with $Cu_2O$ precipitates in Cu was investigated at temperatures between 300—800 K using ion implantation, nuclear-reaction analysis, and transmission electron microscopy. The exothermic reduction reaction between D and $Cu_2O$ to form $D_2O$ was found to occur readily at temperatures down to 300 K, with appreciable decomposition of the water and D release occurring only above 600 K. These processes, together with much weaker irradiation-defect trapping in the implanted Cu-$Cu_2O$-D alloy, were quantitatively described by using an advanced transport formalism with independently evaluated reaction and trapping enthalpies. Buried oxide sinks formed by ion implantation were shown to provide an advantageous method of measuring hydrogen permeabilities and chemical potentials.

8169 **Structural and thermodynamic properties of heavily mechanically deformed Ru and AlRu.** Hellstern, E.; Fecht, H.J.; Fu, Z.; Johnson, W.L. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91125). *Journal of Applied Physics;* **65**: No. 1, 305-310(1 Jan 1989).

We report on high-energy ball milling of Ru and AlRu. The deformation results in a drastic decrease of the crystal size to a nanometer scale and in an increase of atomic-level strain. This is accompanied by a disordering of the crystal lattice as is shown by means of the long-range-order parameter in AlRu. The specific heat increases by more than 15%—20%, indicating large changes in the vibrational and configurational part of the entropy. The stored energy of cold work is up to 6 kJ/mol for AlRu and 10 kJ/mol for Ru. This is almost 40% of the heat of fusion of Ru and exceeds by far the energies stored by other deformation processes.

**8170 Mechanism of surface-limited release of hydrogen from oxidized metals.** Richards, P.M.; Myers, S.M.; Wampler, W.R.; Follstaedt, D.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Journal of Applied Physics;* **65**: No. 1, 180-185(1 Jan 1989).

Analysis has been made of the time dependence of surface recombination and release of deuterium from helium-bubble traps in iron with both clean and oxidized surfaces. In both cases second-order kinetics are obeyed over a large range of time scales, including short times when the traps are saturated. We show this is possible only if, in both cases, release is limited by escape from surface sites which have the same energy as the traps. We therefore propose that the oxide represents an additional barrier, but does not alter the energies of sites from which recombination takes place relative to solution sites. We further show that for both iron and stainless steel the prefactor for the recombination rate is about the same for a bare surface and for an oxide layer. Thus effects of the barrier are mostly on the activation enthalpy of release.

**8171 Standing-wave-assisted extended x-ray absorption fine-structure study of a Ni-Ti multilayer.** Heald, S.M.; Tranquada, J.M. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **65**: No. 1, 290-293(1 Jan 1989).

Extended x-ray absorption fine structure (EXAFS) measurements have been made while simultaneously exciting x-ray standing waves in a multilayer structure. This allows the EXAFS signal from selected regions within the multilayer unit cell to be enhanced. The technique is applied to a Ni-Ti multilayer in which it is verified that strong standing-wave fields can be excited in the presence of substantial interfacial roughness. The measurements reveal little Ni-Ti intermixing and a strong low-Z impurity signal in the Ti layers. The standing-wave analysis indicates that the low-Z impurity is distributed throughout the Ti layers.

**8172 Photodesorption from copper-plated stainless steel at liquid-helium temperature and at room temperature.** Bintinger, D.; Limon, P.; Rosenberg, R.A. (Superconducting Super Collider Central Design Group, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 59-63(Jan 1989).

Photodesorption yields have been measured from copper-plated stainless steel at liquid-helium temperature and at room temperature using synchrotron radiation. The copper-plated surface is a proposed inner surface for the liquid-helium temperature beam pipe of the Superconducting Super Collider (SSC). The inner surface of the SSC beam pipe will be illuminated by synchrotron radiation from 20-TeV protons. The number of $H_2$ molecules desorbed per incident photon (eta/sub =/) from the liquid-helium temperature surface has been measured as ~0.018 for an accumulated photon dose of $10^{16}$ photons/cm$^2$ and as ~0.004 for an accumulated dose of $10^{18}$ photons/cm$^2$. The ratio of eta/sub =/ for the liquid-helium temperature surface to eta/sub =/ for the room-temperature surface is ~1.1 for an accumulated dose of $10^{16}$ photons/cm$^2$ and is ~2.0 for an accumulated dose of $10^{18}$ photons/cm$^2$. Estimates of eta for $H_2O$, CO, and $CO_2$ are also given.

**8173 Experimental and theoretical investigation of hydrogen diffusion on a metal surface.** Felter, T.E.; Stulen, R.H.; Koszykowski, M.L.; Gdowski, G.E.; Garrett, B. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 104-107(Jan 1989).

We describe experimental and theoretical studies of hydrogen diffusion on metal surfaces. The experimental system is H/Pd(111) and we describe the utilization of low-energy electron diffraction in combination with electron stimulation of the surface by the incident beam to investigate surface diffusion. Electron stimulated desorption, as well as disordering are discussed with regard to the interpretation of the experiments. To study surface diffusion theoretically, variational transition state theory is employed. The system studied by this technique is H/Ni(111) and comparison to experiment is given.

**8174 Adsorption of counterions to a stearate monolayer spread at the water-air interface: A synchrotron x-ray study.** Bloch, J.M.; Yun, W.B.; Yang, X.; Ramanathan, M.; Montano, P.A.; Capasso, C. (Exxon Research and Engineering Company, Clinton Township, Annandale, New Jersey 08801). *Physical Review Letters;* **61**: No. 26, 2941-2944(26 Dec 1988).

The near-total-external fluorescence technique was used to measure in situ the adsorption of a metal ion from a subphase solution to the liquid-air interface. For a monolayer formed by the spreading of stearic acid on a 10/sup -3/-mole/l solution of $MnCl_2$, the ratio of Mn ions segregated to the interface to the number of stearate molecules on the surface was determined as 0.6 +- 0.2. Surface extended x-ray-absorption fine-structure experiments revealed local order of Mn ions at the surface in the condensed phase but no order showed in the expanded phase. We explain these findings using a self-consistent Poisson-Boltzmann calculation.

**8175 Structural, electronic, and magnetic properties of clean and Ag-covered Fe monolayers on W(110).** Hong, S.C.; Freeman, A.J.; Fu, C.L. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12156-12163(15 Dec 1988).

The structural, electronic, and magnetic properties of magnetic Fe transition-metal atoms as an overlayer on a nonmagnetic transition metal, W(110), and the effects of a Ag covering on the magnetism of Fe/W(110), are determined by means of the highly precise self-consistent all-electron full-potential linearized-augmented-plane-wave method based on the local-spin-density approximation. The interlayer spacings of Fe-W and Ag-Fe are determined from total-energy calculations. We find that the Fe atoms are relaxed downward (compared to the average of the Fe-Fe and W-W bulk bond lengths) by 9.5% and 4.0% for clean and Ag-covered Fe/W(110), respectively. We find that the hybridization of the W and Fe d bands plays an important role in determining the magnetism of the Fe/W(110) systems. The magnetic moment (2.18$\mu$/sub B/) and the magnitude of the Fermi-contact hyperfine field (-148 kG) of the Fe in relaxed Fe/W(110) are greatly reduced compared to those of the unrelaxed Fe/W(110) (by 0.38$\mu$/sub B/ and 46 kG, respectively). The Ag covering increases the magnitude of the Fermi-contact term of the Fe by 29 kG by encouraging the indirect covalent spin polarization of the s-like electrons. If one includes estimates of the dipolar and unquenched orbital-angular-momentum contributions, then our calculated values of the hyperfine field are found to be in remarkable agreement with recent conversion-electron Moessbauer-spectroscopy experimental values.

**8176 Interface-state properties for strained-layer Ni adsorbed on Ru(0001).** Houston, J.E.; White, J.M.; Feibelman, P.J.; Hamann, D.R. (Sandia National Laboratory, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12164-12170(15 Dec 1988).

Studies of ultrathin layers of Ni on Ru(0001) by He I photoemission and theoretical calculations reveal the existence of surface and interface states resulting from the Ni(3d)-Ru(4d) interaction. Pure Ni surface states are found centered at a binding energy of about -1.4 eV. Split about this position are two pairs of Ni-Ru states of different symmetry character. The highest lying of these states is identified as an interface state of mostly Ni character and d$\sigma$ symmetry, while the most tightly bound ones are identified as mostly Ru in character and of d$\sigma$ symmetry. The splitting between these interface states is 3.1 eV, reflecting a combination of the d-band offset of Ni relative to Ru and the level repulsion engendered by the Ni-Ru interaction. A similar combination of states with mixed d$\pi$-d$\delta$ symmetry is found having a splitting of about 2.7 eV. Analogous states are found for the Cu/Ru(0001) bimetallic system. The two systems differ principally due to the relative positions of the d states for Cu (deeper) compared to Ni.

8177 **Electrical field effects near the metal-insulator transition.** Osofsky, M.; Bieri, J.B.; LaMadrid, M.; Contrata, W.; Mochel, J.M. (Materials Research Laboratory, University of Illinois at Urbana-Champaign, 104 South Goodwin Avenue, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12215-12227(15 Dec 1988).

A detailed study of the nonlinear conductivity of two disordered alloys, Ge/sub x/Au/sub 1-//sub x/ and C/sub x/Cu/sub 1-//sub x/, is carried out near their metal-insulator transition on the metallic side for 1.3 K<T<4.2 K and for electric fields E up to 500 V/cm. Analyzing the $\sigma$(E) data in the context of an electron-gas—heating model yields unacceptably long electron relaxation times. Alternatively, the electric field can limit renormalization by pumping the electrons' energy above the disordered potential. The system then changes from quantum-mechanical scaling to classically diffusive behavior beyond a certain length scale. The temperature and electric field data can then give the characteristic lengths and prefactors for the metal-insulator transition.

8178 **Unoccupied states on Pd(110) and the surface potential barrier.** Smith, N.V.; Chen, C.T.; Tranquada, J.M.; Johnson, P.D. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974-2070). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12259-12262(15 Dec 1988).

Inverse photoemission spectra on Pd(110) reveal bulk band-structure features, and surface-state features in the projected gaps centered at points Y-bar and X-bar. The energy dispersion of the bulk band-structure features is in agreement with direct-transition predictions. Surface-state energies and their dispersion are reproduced with a nearly-free-electron model and a surface-barrier model which places the image plane 2.3 a.u. beyond the outermost atomic layer. The experimentally determined energies of surface states are as follows: at point X-bar, 6.6 eV above E/sub F/, designated $S_6^+$; at point Y-bar, 3.4 and 6.6 eV above E/sub F/, designated $S_6^+$ and $S_1^-$, respectively.

8179 **Structure and bonding in photodiffused amorphous Ag-$GeSe_2$ thin films.** Fischer-Colbrie, A.; Bienenstock, A.; Fuoss, P.H.; Marcus, M.A. (Department of Materials Science and Engineering, Stanford University, Stanford, California 94305-2205). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12388-12403(15 Dec 1988).

Grazing-incidence x-ray scattering (GIXS) techniques have been used to study the local and intermediate-range order in photodiffused amorphous Ag-$GeSe_2$ thin films and a variety of Ag-Ge-Se alloys. Using synchrotron-radiation sources, the GIXS technique can be used in conjunction with radial-distribution-function analysis, differential anomalous x-ray scattering, and differential distribution-function analysis to study the structure of very thin amorphous films. With these techniques, we have determined that the local atomic structure of Ag-$GeSe_2$ films satisfies a model where Se-Ag dative bonds are formed, one Se-Ag covalent bond is formed for each Ag atom added (below a critical composition), and Ge-Ge bonds are created as Ag is added. This last result significantly modifies the intermediate-range order in this system.

8180 **Calculation of the thermal expansion of metals using the embedded-atom method.** Foiles, S.M.; Daw, M.S. (Sandia National Laboratories, Livermore, California 94551). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12643-12644(15 Dec 1988).

The linear coefficient of thermal expansion of the fcc metals Cu, Ag, Au, Ni, Pd, and Pt are computed using the semiempirical embedded-atom method to determine the energetics. The results are in good agreement with experiment. The importance of including the equation of state in the determination of the empirical functions is discussed.

8181 **Surface-phonon calculations for the Al(110) surface.** Ho, K.M.; Bohnen, K.P. (Ames Laboratory, U.S. Department of Energy, and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 12897-12902(15 Dec 1988).

The frequencies of surface modes at high-symmetry points of the surface Brillouin zone have been calculated with interplanar surface force constants determined from first-principles self-consistent total-energy calculations for the Al(110) surface. The multilayer relaxation for this surface produces big deviations of the surface force constants from the bulk values.

8182 **Electronic and superconducting properties of Mo-Ta superlattices.** Maritato, L.; Cucolo, A.M.; Vaglio, R.; Noce, C.; Makous, J.L.; Falco, C.M. (Dipartimento di Fisica, Universita degli Studi di Salerno, I-84100 Salerno, Italy). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 12917-12921(15 Dec 1988).

We obtain bcc-bcc Mo-Ta superlattices in the modulation wavelength range 16—450 A. The x-ray analysis shows long structural coherence even in the short-modulation-wavelength limit, and the resistivity data are in the metallic regime. We find the "universal" behavior of the T/sub c/ versus rho curve already seen in other metals, compounds, and alloys and, for superlattices in the range 50—250 A, the dV/dI versus V characteristics show a double-peak structure. The temperature behavior of these peaks is fitted by a two-band model and by a proximity-effect theory.

8183 **Infinite screening and cluster calculations of ionization potentials.** Nordfors, D.; Ma-circlertensson, N.; Agren, H. (Department of Physics, University of Uppsala, Box 530, Uppsala, Sweden). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 12922-12928(15 Dec 1988).

Using beryllium as a model system it is suggested that cluster simulations of core-electron ionization potentials in metals should be carried out with the same number of electrons in the initial and final states.

8184 **Ellipsometric study of optical transitions in Ag/sub 1-//sub x/In/sub x/ alloys.** Kim, K.J.; Chen, L.; Lynch, D.W. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50010). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 13107-13112(15 Dec 1988).

The dielectric functions of disordered Ag/sub 1-//sub x/In/sub x/ alloys ($x \leqq 0.12$) were obtained ellipsometrically in the 1.2—5.5-eV energy region. In the low-energy region, the intraband scattering rate, described by tau/sup -1/ = $\text{tau}_0$/sup -1/ + $\beta\omega^2$, increases with increasing In concentration. The increasing positive values of $\beta$ with increasing In content do not agree with a calculation based on the assumption of a spherical Fermi surface and isotropic scattering from an impurity represented by a screened Coulomb potential. The onset energy of the $L_3 \rightarrow L_2$/sup '/(E/sub F/) transition, 4.03 eV for pure Ag, shifts to higher energies, while that of the $L_2$/sup '/(E/sub F/)$\rightarrow L_1$ transition, 3.87 eV for pure Ag, shifts to lower energies. This is only partly attributable to the rise of the Fermi level E/sub F/ caused by an increase in the average number of electrons per atom due to the In solute and to the narrowing of the Ag 4d bands. The $L_1$ band may also lower as In is added.

8185 **Atomiclike behavior of the Mo 4d photoionization cross section in Mo islands grown on Al.** Puppin, E.; Lindau, I.; Braicovich, L. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 13412-13414(15 Dec 1988).

The Mo 4d photoionization cross section has been measured, apart from a constant factor, in the photon energy range 63—200 eV from samples consisting of Mo islands grown on Al at 80 K. Within the experimental error the photoionization cross section is in basic agreement with the atomic calculations, in spite of the fact that a considerable d-d interaction between nearby Mo atoms is present. The problems raised by the present results are discussed in connection with the physics of clusters.

8186 **Freely-migrating-defect production during irradiation at elevated temperatures.** Hashimoto, T.; Rehn, L.E.; Okamoto, P.R. (Energy Research Laboratory, Hitachi Ltd., 1168 Moriyamacho, Hitachi, Ibaraki 316, Japan). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 12868-12878(15 Dec 1988).

Radiation-induced segregation in a Cu—1 at. % Au alloy was investigated using in situ Rutherford backscattering spectrometry. The amount of Au atom depletion in the near surface region was measured as a function of dose during irradiation at 350 °C with four ions of substantially different masses. Relative efficiencies for producing freely migrating defects were evaluated for 1.8-MeV $^{1}$H, $^{4}$He, /sup 20/Ne, and /sup 84/Kr ions by determining beam current densities that gave similar radiation-induced segregation rates. Irradiations with primary knock-on atom median energies of 1.7, 13, and 79 keV yielded relative efficiencies of 53, 7, and 6 %, respectively, compared to the irradiation with a 0.83-keV median energy. Despite quite different defect and host alloy properties, the relative efficiencies for producing freely migrating defects determined in Cu-Au are remarkably similar to those found previously in Ni-Si alloys. Hence, the reported efficiencies appear to offer a reliable basis for making quantitative correlations of microstructural changes induced in different alloy systems by a wide variety of irradiation particles.

8187 **Magnetism in the heavy-electron superconductors $UPt_3$ and $URu_2Si_2$.** Norman, M.R.; Oguchi, T.; Freeman, A.J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11193-11198(1 Dec 1988).

The nature of magnetism in the heavy-electron superconductors $UPt_3$ and $URu_2Si_2$ is investigated by using a spin-orbit generalized variant of local-spin-density (LSD) theory to calculate the self-consistent moment-polarized electronic structure and the dynamic (bare-band) susceptibility. It is shown that the direction of the magnetic moment is predicted correctly. The size of the moment, however, is 0.8$\mu$/sub B/ in $UPt_3$ and 1.2$\mu$/sub B/ in $URu_2Si_2$, i.e., a factor of 40 larger than experiment. It is noted, however, that the experimental moment of (0.65 +- 0.1)$\mu$/sub B/ for Th- or Pd-doped $UPt_3$ is close to the theoretical value. The static susceptibility, chi(q), is predicted to be weakly dependent on q except for $UPt_3$, where a peak is found at q = ($\pi$/c)(0,0,2): in general agreement with neutron-scattering data at high frequencies. The low-frequency anomalies in the neutron data which lead to magnetic ordering are not seen in the calculated dynamic susceptibility, but can be understood in terms of a moment-moment interaction. An explanation for these conflicting data is offered based on the interaction of itinerant quasiparticle and local-moment degrees of freedom at low temperatures, which leads to a renormalization of the LSD spin-spin response function.

8188 **Raman scattering from vibrational and magnetic modes in Dy, Er, and Y films.** Demers, R.T.; Kong, S.; Klein, M.V.; Du, R.; Flynn, C.P. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11523-11533(1 Dec 1988).

Inelastic-light-scattering spectra were measured in molecular-beam-epitaxy—grown single-crystal films of dysprosium, erbium, and yttrium. Polarized Raman scattering was used to probe vibrational and electronic excitations in Dy, Er, and Y, and magnetic excitations in Dy. The vibrational light-scattering measurements have revealed an anomalous temperature dependence of the Brillouin-zone-center transverse-optical (TO) phonon in Dy and Er. Previous measurements of the thermal expansion of bulk Dy and Er indicate that this temperature dependence cannot be explained by lattice anharmonicity and the related volume change. The hardening of this mode may be due in part to the coupling of the TO phonon to the ordered magnetic moments. The ferromagnetic acoustic-spin-wave gap in Dy was observed. The light-scattering measurement of the spin-wave gap energy agrees with and corroborates earlier infrared resonance measurements in bulk Dy. The observation of the optical spin wave in ferromagnetic Dy is forbidden by Raman selection rules. The optical spin wave in spiral-phase Dy was not observed. A broad low-intensity peak centered at about zero energy shift was observed in Er, Dy, and Y films and in bulk Zn. This may be due to interband electronic scattering or two-phonon scattering. The LO phonon was observed in Dy, Er, and Y due to weak disorder.

8189 **Rotational magnetic processes in a dirty superconductor.** Liu, L.; Kouvel, J.S.; Brun, T.O. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11799-11801(1 Dec 1988).

Magnetization-vector (M) measurements were made on a thin disk of impure Nb rotated relative to a fixed field H at 4.2 K. For all H, M is found to be separable into a nonrotating diamagnetic component M/sub d/ plus a penetrating-flux component M/sub p/ that turns rigidly with the sample for small rotation angles. For H below H/sub $c_1$ on a hysteresis loop, M/sub p/ diminishes in size but continues to rotate rigidly up to 360°. For H between H/sub $c_1$ and H/sub $c_2$, M/sub p/ rotates up to and then remains at some critical angle, indicating a constant frictional torque between M/sub p/ and the sample, which presumably arises from vortex-flux jumps between pinning centers. Moreover, M/sub d/ closely equals -H/4$\pi$ for H above as well as below H/sub $c_1$.

8190 **Temperature dependence of the high-energy magnetic excitations for Ni.** Mook, H.A.; Paul, D.M.; Hayden, S. (Oak Ridge National Laboratory, Solid State Division, Oak Ridge, Tennessee 37831-6031). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 12058-12061(1 Dec 1988).

High-resolution neutron scattering measurements have been made on the high-energy magnetic excitations for Ni for different temperatures. It is shown that these excitations are not strongly affected by temperatures on the order of the Curie temperature. This shows that very high neutron energies must be used if the paramagnetic susceptibility is to be obtained by energy integration of the total scattering.

8191 **Surface electromagnetic modes in prolate spheroids of gold, aluminum, and copper.** Bloemer, M.J.; Buncick, M.C.; Warmack, R.J.; Ferrell, T.L. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6123). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 12, 2552-2559(Dec 1988).

Optical absorbance measurements are presented for discontinuous films of gold, aluminum, and copper as a function of wavelength, polarization, and angle. Anomolous peaks in the absorbance spectra are observed for all three metals. Two peaks are detected for gold, and one peak is detected for both aluminum and copper. Comparison with electromagnetic theory is made on the basis that the microstructures can be modeled as prolate spheroids. The theoretical model is tested experimentally for various minor-to-major-axis ratios of the spheroid.

8192 **Method for preparing hydride configurations and reactive metal surfaces.** Silver, G.L. (to Dept. of Energy, Washington, DC). US Patent 4,764,228. 16 Aug 1988. Filed date 28 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for preparing highly hydrogen-reactive surfaces on metals which normally require substantial heating, high pressures, or an extended induction period, which involves pretreatment of the surfaces with either a non-oxidizing acid or hydrogen gas to form a hydrogen-bearing coating on the surfaces, and subsequently heating the coated metal in the absence of moisture and oxygen for a period sufficient to decompose the coating and cooling the metal to room temperature. Surfaces so treated will react almost instantaneously with hydrogen gas at room temperature and low pressure. The method is particularly applicable to uranium, thorium, and lanthanide metals.

8193 **Method and apparatus for determining weldability of thin sheet metal.** Goodwin, G.M.; Hudson, J.D. (to Dept. of Energy, Washington, DC). US Patent 4,763,521. 16 Aug 1988. Filed date 31 Mar 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes apparatus for evaluating the hot-cracking sensitivity of a sheet of metal during welding thereof by changes in a preselected stress applied on the sheet of metal prior to the welding to determine weldability of the metal, comprising a base, a first jaw support means secured to a planar surface on the

base, second jaw support means supported on the planar surface of the base and movable thereon with respect to the first jaw support means, grip means carried by the first and second jaw support means for securing a sheet of metal to be autogenously welded thereacross between the first and second jaw means along a plan coplanar with the planar surface, load inducing means coupled to the second jaw support means for urging the second jaw support means away from the first jaw support means to stress the sheet of metal in a direction transverse to the direction of welding of the sheet of metal, adjusting means associated with the load inducing means for applying a preselected stress on the sheet of metal prior to welding, and load cell means coupled to the load inducing means for providing a signal indicative of changes in the reselected stress during welding of the sheet of metal.

8194 **Microstructure effects on tensile properties of tungsten-nickel-iron composites.** Rabin, B.H.; German, R.M. (EG and G, Idaho Falls, ID (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **19A**: No. 6, 1523-1562(Jun 1988).

Controlled processing of heavy alloys containing 88 to 97 pct W resulted in high sintered densities and excellent bonding between the tungsten grains and matrix. For these alloys, deformation and fracture behavior were studied via slow strain rate tensile testing at room temperature. The flow stress increased and the fracture strain decreased with increasing tungsten content. The tradeoff between strength and ductility resulted in a maximum in the ultimate tensile strength at 93 pct W. Microstructure variations, notably grain size, explain sintering temperature and time effects on the properties. During tensile testing, cracks formed on the surface of the specimens at tungsten-tungsten grain boundaries. The crack density increased with plastic strain and tungsten content. The surface cracks, through initially blunted by the matrix, eventually increased in density until catastrophic failure occurred. An empirical failure criterion was developed relating fracture to a critical value of the surface crack tip separation distance. Application of the model explains the effects of microstructural variables on tensile properties.

8195 **Tensile deformation behavior of mechanically stabilized Fe-Mn austenite.** Tomota, Y.; Strum, M.; Morris, J.W. Jr. (Lawrence Livermore National Lab., Livermore, CA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **19A**: No. 6, 1563-1580(Jun 1988).

The tensile deformation behavior of mechanically-stabilized austenite is investigated in Fe-Mn binary alloys. A 30 pct thickness reduction by rolling at 673 K (above the A/sub f/ temperature) largely suppresses the austenite ($\gamma$) to hcp epsilon martensite (E) transformation in 17Mn and 25Mn steels. However, the deformation behavior of the mechanically stabilized austenite in the two alloys differs significantly. In 25Mn steel, the onset of plastic deformation is due to the stress-induced $\gamma \rightarrow$ E transformation and results in a positive temperature dependence of the yield strength. The uniform elongation is enhanced by the $\gamma \rightarrow$ E transformation during deformation. In 17Mn steel, bcc $\alpha'$ martensite is deformation-induced along with E and a plateau region similar to Luders band deformation appears at the beginning of the stress-strain curve. The mechanical stabilization of austenite also suppresses the intergranular fracture of 17Mn steel at low temperatures.

8196 **Change in direction of carbon thermotransport in Nb-V system with alloying.** Uz, M.; Carlson, O.N. (Ames Lab., Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **19A**: No. 6, 1429-1438(Jun 1988).

Thermotransport of carbon in a complete series of Nb-V alloys was studied using a radioactive tracing technique. The heat of transport Q of carbon in Nb and V is negative; i.e. thermotransport is toward the hotter regions. Marked changes in the value of Q result from alloying of the two metals, however, and an unusual reversal in its sign, i.e., a reversal in thermotransport direction, occurs at -- 1.5 at. pct V on the Nb-rich end, and again at -- 25 at. pct Nb on the V-rich end of the system. It increases rather sharply from - 54.8 kJ/mol in pure niobium to + 7.6 kJ/mol at 2.5 at. pct V, and reaches a maximum of + 43.6 kM/mol at approximately 25 at. pct V. Further increase in the V content results in a more gradual decrease in Q to its value of - 42.3 kJ/mol in pure vanadium. Possible explanations of these results based on current theories of thermotransport are presented, and the implications from an engineering standpoint are examined.

8197 **Submicron defects in rapidly solidified Type 304 stainless steel powders containing noble gases.** Bae, J.C.; Kelly, T.F.; Flinn, J.E.; Wright, R.N. (Dept. of Metallurgical and Mineral Engineering, Univ. of Wisconsin-Madison, Madison, WI (US)). *Scripta Metallurgica;* **22**: No. 5, 691-696(May 1988).

The purpose of this work is to examine the defect microstructure of 304 SS powders processed by different atomization methods. The powders examined were processed by centrifugal atomization (CA) and vacuum gas atomization (VGA). In the CA process the molten droplets exiting from the spinning cup were convectively cooled with flowing helium. The VGA process involves pressurizing and mechanical mixing of the melt with argon. The entrapped argon in the melt, as well as the carrier argon associated with the melt stream, produces the molten droplets. Optical microscopy was performed on screened particle sizes to resolve the morphological features such as porosity and solidification microstructure.

8198 **Statistical analysis of microhardness data in boron softened Ni/sub 3/Al.** Qian, X.R.; Chou, Y.T. (Dept. of Materials Science and Engineering, Lehigh Univ., Bethlehem, PA (US)). *Scripta Metallurgica;* **22**: No. 5, 725-727(May 1988).

In a recent paper, the authors reported that the microhardness of stoichiometric Ni/sub 3/Al alloy could be lowered by the addition of boron. The lowering in hardness was observed both in grain interiors and on grain boundaries, indicating that under localized deformation boron could soften the material. Although the data are convincing, they only represent a random sample drawn from the population. For a more general conclusion, it is appropriate to make estimates about the population mean, $\mu$, and population standard deviation, $\sigma$, by using statistical methods. Such an analysis is presented in this note. In particular, the 95% confidence intervals for $\mu$ and $\sigma$ are evaluated; the difference between the $\mu$'s of the boron-free and boron-doped alloys is estimated.

8199 **Effects of hydrogen on low temperature hardening and embrittlement of V-Cr alloys.** Owen, C.V.; Spitzig, W.A. (Ames Lab., Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 9, 1593-1602(Sep 1987).

The effects of H on the strength and ductility of V-Cr alloys were investigated from 78 to 300 K. Alloy softening which was observed at low temperatures for a V-2.5Cr alloy was mitigated by the addition of H. Hydrogen embrittlement, as measured by reduction of area, was observed in both hydride forming and nonhydride forming alloys. Analysis of the strengthening in hydrogenated V-Cr alloys showed that the predominate effect of H was to increase the thermally activated component of the yield stress. Comparison of the solid solution hardening effect caused by Cr or Ti in V showed that Ti produces greater strengthening, atom for atom, than does Cr, but that the difference cannot be explained solely by larger size and modulus misfits of solute and solvent atoms.

8200 **The effect of hydrogen on fracture toughness of the Fe-Ni-Co superalloy IN903.** Moody, N.R.; Stoltz, R.E.; Perra, M.W. (Sandia National Labs., P.O. Box 969, Livermore, CA (US)). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 8, 1469-1482(Aug 1987).

Fracture toughness values and tensile properties were determined in the Fe-Ni-Co superalloy IN903 as a function of hydrogen concentration, loading rate, and grain size to define the effects of hydrogen on fracture toughness and failure modes. Tests using precracked, precharged three point bend samples showed that fracture toughness decreased from 90 to 50 MPa-m/sup 1/2/ as hydrogen increased from zero to 5000 appm. The decrease in fracture toughness was accompanied by a fracture mode change from microvoid

coalescence in the uncharged samples to principally slip band fracture with some twin band and ductile intergranular fracture in the hydrogen charged samples. Fractographic observations and application of ductile fracture toughness models showed that fracture initiated at matrix carbides in all samples. These carbides established the critical fracture distance for all fracture processes observed in the fracture toughness samples. Hydrogen promoted the secondary fracture processes of slip band, twin band, and ductile intergranular fractures which lowered vboth the critical fracture strain and the fracture toughness of IN903.

8201 **Internal friction study of substitutional-interstitial interaction in niobium-vanadium alloys.** Carlson, O.N.; Indrawirawan, H.; Owen, C.V.; Buck, O. (Dept. of Materials Science and Engineering, Iowa State Univ., and Ames Lab., Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 8, 1415-1420(Aug 1987).

The effect of small addition of a substitutional solute to both niobium and vanadium on the oxygen Snoek peak of each metal was investigated by an internal friction technique. A vanadium-oxygen interaction peak was identified in Nb-0.24 at. pct V and Nb-0.50 at. pct V alloys at a temperature which is appreciably higher than that for the oxygen Snoek peak in pure niobium. At oxygen concentrations greater than an oxygen/vanadium ratio of 1, the oxygen Snoek peak appears, thus providing strong evidence for oxygen trapping at vanadium in these alloys. A V-0.50 at. pct Nb alloy, on the other hand, shows no such interaction peak but rather only a somewhat broadened vanadium-oxygen Snoek peak. This is interpreted as indicating that oxygen atoms are not trapped by niobium in the vanadium matrix. The activation enthapies and time constants for the oxygen relaxation for the peaks have been determined. The observed results are discussed in terms of the elastic and chemical interaction models for substitutional-interstitial solute interactions in a bcc lattice.

8202 **Grain size and hydrogen concentration effects on the ductility return in a refractory alloy.** Owen, C.V.; Cheong, D.S.; Buck, O. (Ames Lab. - U.S.-D.O.E., Iowa State Univ., Ames, IA (US)). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **18A**: No. 5, 857-864(May 1987).

The effects of grain size (in the range of 30 to 220 $\mu$m) and hydrogen concentration on the ductility return of a hydrogen doped 25 at. pct V-75 at. pct Nb alloy was investigated at low strain rates. Since this alloy has a large terminal hydrogen solubility and since the hydrogen additions were kept low, hydride formation seems not to contribute to the alloy's embrittlement. It was found that the ductility return is present only for small grain sizes and low hydrogen concentrations. Cracks leading to failure were initiated intergranularly. It appears to be unlikely that the ductility return, if present, is caused by the low diffusivity of hydrogen in that temperature range. A qualitative model is proposed to explain the observations.

8203 **Thermomechanical fatigue of type 304 stainless steel.** Majumdar, S. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL (US)). pp 31-36 of Thermal stress, material deformation, and thermo-mechanical fatigue. Sehitoglu, H.; Zamrik, S.Y. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

Results are summarized for thermochemical fatigue tests conducted between 427°C (800°F) and 593°C (1100°F) on type 304 stainless steel. The isothermal continuous-cycling fatigue behavior of type 304 stainless steel varies from a minimal dependence of life on strain rate at the coolest temperature [427°C (800°F)] to a significant strain rate effect on life at the highest temperature ([593°C (1100°F)]. On the other hand, thermochemical fatigue tests conducted between the same two temperature limits show a complex behavior dependent on temperature, strain, and their phases during cycling. In general (not always), for cycles at relatively high strain ranges (>0.5%), in-phase thermomechanical cycling is the most damaging, followed by isothermal cycling at the highest temperature, which in turn is followed by out-of-phase thermomechanical cycling, and finally, the least damaging of all, isothermal cycling at the lowest temperature of the cycle. The failure mechanisms in these tests can vary significantly. The damage rate equations that are proposed by the author for predicting lives of isothermal fatigue tests can be successfully used to predict the lives of all the thermomechanical tests conducted to date on the basis of parameters derived from isothermal tests. The approach also correctly predicts the observed fracture modes.

8204 **Development of a uniaxial constitutive model for a strain induced softening material.** Handrock, J.L.; Marriott, D.L.; Stubbins, J.F. (College of Engineering, Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). pp 83-90 of Thermal stress, material deformation, and thermo-mechanical fatigue. Sehitoglu, H.; Zamrik, S.Y. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

In recent years the demands for greater material performance have steadily increased. As a consequence, materials which have previously been rejected for use in certain applications are once again being considered. Such is the current case involving the use of quenched and tempered low alloy for Cr Mo steels for pressure vessel construction. When heat treated in this manner this material produces a bainitic microstructure which has improved short term strength characteristics over the more commonly used annealed form. It has been found, however, that the bainitic microstructure softens significantly under cyclic loading. As a result, for determining allowable design stresses, a criteria needs to be developed to judge whether use of the fully heat treated strength is justified, or whether it is necessary to take into consideration a softened state of the material. To gain an understanding of the limiting stress/strain range which will induce significant softening, a time dependent uniaxial constitutive model of strain induced softening has been developed. This model was formulated from a given set of elevated temperature cyclic test results. In this model strain induced softening is postulated to be a function of accumulated plastic strain. Predictions made using this model are compared with results obtained experimentally.

8205 **Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel.** Swindeman, R.W.; Robinson, D.N. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 91-98 of Thermal stress, material deformation, and thermo-mechanical fatigue. Sehitoglu, H.; Zamrik, S.Y. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870636—).

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

Annealed 2.25Cr-1Mo steel was examined under isothermal and thermal ratchetting conditions. Peak temperatures were in the range of 454 to 538°C. At the lower temperatures and in the absence of long hold times cycling hardening occurred. At higher temperatures ratchetting rates in two-bar experiments were approximately constant. Recovery of the yield strength during the hold period at the peak temperature was thought to be the most significant factor controlling the ratchetting.

8206 **Modified 14Cr-16Ni stainless steels with improved creep resistance at 700°C due to tailored precipitate microstructures.** Maziasz, P.J.; Swindeman, R.W. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 283-290 of Advances in material technology for fossil power plants. Viswanathan, R.; Jaffee, R.I. Metals Park, OH; American Society for Metals (1987). (CONF-870980—).

From International conference on advances in material technology for fossil power plants; Chicago, IL, USA (1 Sep 1987).

The compositions of several 14Cr-16Ni (2.5Mo, 2Mn) austenitic stainless steels were modified with combinations of minor and residual alloying elements to produce excellent creep strength based on unique precipitate microstructures. These modifications produce fine MCand FeTiP precipitate particles in the matrix for strength, and combinations of coarser M/sub 23/C/sub 6/, M/sub 6/C and

MC, particles along the grain boundaries for improved ductility and rupture resistance. The creep-rupture resistance of these modified 14-16 steels is superior to that of type 316 or alloy 800H and better than that of 17-14CuMo at 700°C in the mill-annealed condition. These new steels approach the creep resistance of alloy 617 at 700 to 760°C. Analysis of microstructure and correlation with creep properties suggests that precipitate effects are primarily responsible for the improvement in mechanical properties. The design of the novel precipitate microstructures is based on microcompositional information obtained using state-of-the-art analytical electron microscopy (AEM).

8207 **The effect of minor alloying additions on the mechanical properties of type AISI 316 stainless steels.** Carolan, R.A.; Li, C.Y.; Swindeman, R.K. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 275-283 of Advances in material technology for fossil power plants. Viswanathan, R.; Jaffee, R.I. Metals Park, OH; American Society for Metals (1987). (CONF-870980—).

From International conference on advances in material technology for fossil power plants; Chicago, IL, USA (1 Sep 1987).

THE TYPE 316 CLASS of stainless steels have been modified in the past to enhance high temperature flow strength by minor (<1%) Ti/Nb additions that precipitate grain matrix MC type carbides during thermo-mechanical pre-treatment or during the initial stages of creep/service life. Another approach has been to use copper additions (—3%). The reason for this improvement is not well understood. This paper reports the synergistic effects of a combination of copper and Ti/Nb/V additions in a new series of alloys developed at Oak Ridge National Laboratory. These alloys show promise for use in advanced steam cycle plants and other applications. The objectives of the work reported are: To ensure that the flow strength of the alloys will meet the advanced steam cycle plant mechanical design requirements. These requirements specify a stress to rupture of at least 96MPa for a life of 10/sup 5/ hrs at 700°C and preferably 117MPa; to optimize thermo-mechanical pretreatment in terms of: a) solution treatment temperature, cold work, and stabilization aging, and b) solution treatment temperature alone, and to ensure that the alloys have good fabricability and weldability. The load relaxation test has been the major tool of this investigation together with creep testing for the evaluation of flow properties.

8208 **Long-term-creep and creep-crack-growth behavior of 9Cr-1Mo-V-Nb steel.** Jaske, C.E.; Swindeman, R.W. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 257-258 of Advances in material technology for fossil power plants. Viswanathan, R.; Jaffee, R.I. Metals Park, OH; American Society for Metals (1987). (CONF-870980—).

From International conference on advances in material technology for fossil power plants; Chicago, IL, USA (1 Sep 1987).

A 9Cr-1Mo-V-Nb steel, ASME SA387, Grade 91, has been developed for use at temperatures up to 600 C. In the current study, the long-term creep and creep-crack-growth behavior of that steel have been characterized for use in engineering analysis and life assessment. Results of short-term creep-rupture tests conducted for periods of 10 to 10,000 hours to failure were used to develop a simple expression that described the creep response of this steel. That creep expression then was verified for application to lower stress levels and longer times by comparing its predictions with the results of creep tests conducted at lower stress levels and for test times in excess of 10,000 hours. Reasonable predictions were obtained for specimens from the same heat of material that was used to develop the creep expression and heat-to-heat variations in long-term creep response were predictable. Long-term creep-crack-growth behavior was characterized at 538 and 593 C using 25-mm thick (IT) compact-type (CT) specimens tested under step loading conditions.

8209 **Superconductivity at contact of ultrathin gold films with amorphous germanium.** Dwir, B.; Deutscher, G. (Tel-Aviv Univ. (Israel)). pp 23-28 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Ultrathin films of Indium, Aluminum and Gold, in intimate contact with Germanium, show interesting electrical properties. Due to good wetting properties, continuity is reached at very small thickness. Au films (8-24A) have been found to be superconducting (T/sub c/ similarly ordered 1K) with relatively high critical current density and high critical fields, and to have a reduced number of carriers with a high effective mass. The interplay between disorder and superconductivity is observed as a function of the Au film thickness.

8210 **Flux lattice melting in amorphous composite In/InO/sub x/ thin film superconductors.** Gammel, P.L.; Hebard, A.F.; Bishop, D.J. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 85-94 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The mechanical response, comprising longitudinal sound velocity and damping, of amorphous In/InO/sub x/ is studied as a function of normal state sheet resistance. The films are sputtered directly onto a high Q oscillator fabricated from single crystal silicon. With a resonant frequency near 3 KHz, the oscillators have Q's of $10^5$ and a frequency stability of $10^{-8}$. This allows for a unique measurement of the dynamics of magnetic vortices, induced by a field perpendicular to the plane of the sample. The melting of the vortex lattice is signaled by a peak in the attenuation and a frequency shift of the silicon oscillator. The zero field melting temperature and the magnitude of the frequency shift are described by a model of Kosterlitz-Thouless melting due to D.S. Fisher. The temperature dependence of the melting does not agree with this calculation.

8211 **Heavy electron superconductivity: from 1K to 90K to ?.** Pethick, C.J.; Pines, D. (Univ. of Illinois, Urbana (USA)). pp 201-214 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The experimental results and physical arguments are reviewed which led to the conclusion that in heavy electron systems the physical mechanism responsible for superconductivity is an attractive interaction between the heavy electrons which results from the virtual exchange of antiferromagnetic f-electron moment fluctuations. In these systems, then, the superconductivity is of purely electronic origin; the phonon-induced interaction between electrons which leads to superconductivity in ordinary metals plays little or no role.

8212 **Critical fields of $UBe_{13}$ films.** Kang, J.H.; Maps, J.; Goldman, A.M.; Brooks, J.S.; Fisk, Z.; Smith, J.L. (Univ. of Minnesota, Minneapolis (USA)). pp 215-221 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The temperature dependences of the parallel and perpendicular critical magnetic fields of polycrystalline $UBe_{13}$ films have been measured. The ratio of the critical fields, H/sub c11//H/sub c perpendicular to/, has been found to be 1.25 at low temperatures, a value less than would be expected for s-wave pairing without surface pair-breaking but greater than expected for any pairing configuration which is a pure angular momentum state with L not equal to 0. Similar efforts directed at the preparation of $UPt_3$ films were unsuccessful because of the formation of an impurity phase of UPt which is a ferromagnet.

8213 **Kondo lattices: possible mechanism for a non-phonon superconductivity, magnetic-field-induced superconductivity.** Hudak, O. pp 223-231 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

In recent years large interest in new mechanisms of superconductivity appeared due to rising number of new classes of su-

perconducting materials with their properties differing from those of previously known, in particular, heavy fermion systems and oxide superconductors. In this paper results are presented concerning the examination of possible mechanism for a nonphonon superconductivity in Kondo lattices and a suggestion is made for a new mechanism of a magnetic-field-induced superconductive state in heavy fermion systems with appropriate macroscopic symmetry.

8214 **Ultrasonic investigation of novel superconducting systems.** Levy, M.; Schenstrom, A.; Sun, K.J.; Sarma, B.K. (Univ. of Wisconsin, Milwaukee (USA)). pp 243-252 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Ultrasonic attenuation measurements are reported for the superconducting, normal, and mixed states of the heavy Fermion superconductors $UPt_3$ and $URu_2Si_2$ and in the alloys of the ternary superconductors Er/sub 1-x/Ho/sub x/$Rh_4B_4$. A peak in attenuation in the mixed state of $UPt_3$ may be indicative of collective excitations of the flux line lattice. A broad maximum in attenuation is found below the superconducting transition temperature of $URu_2Si_2$. An increase in attenuation in the superconducting phase of the reentrant ternary superconductors with $x = 0.6$ and 0.813 is ascribed to increased spin phonon interaction induced by superconducting screening of crystalline electric fields.

8215 **Non-Phonon mechanisms of superconductivity in high T/sub c/ superconducting oxides and other materials and their manifestation.** Kresin, V.Z. (Univ. of California, Berkeley (USA)). pp 309-322 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC03-76SF00098.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Low dimensionality and the unusual parameter values in the high T/sub c/ materials lead to a key contribution of the plasmon mechanism of superconductivity. In addition, these systems provide a unique opportunity to observe a multigap structure. The problem of the lattice instability is discussed. A manifestation of non-phonon mechanisms (NPM) in $Nb_3Ge$ and the contribution of the intramolecular vibrations are analyzed. Proximity systems containing high T/sub c/ superconductors are promising from the point of view of possible applications.

8216 **Spalling of flat plates by thermal shock.** Thouless, M.D. (Lawrence Berkeley Lab., CA (USA)). *Journal of the American Ceramic Society;* **68**: No. 4, C.111-C.112(Apr 1985). Contract AC03-76SF00098.

A model is presented for the thermal shock damage in plates subjected to a sudden rise in temperature. Spalling is assumed to follow localized buckling caused by the thermally induced compressive stresses above subsurface flaws. The minimum size of flaw required to cause spalling is determined as a function of the material properties of the plate, the temperature rise, the position of the flaw, and the time after the thermal shock. 5 references, 2 figures.

8217 **Wear induced deformation of Ni/sub 3/Al, (Fe,Co)/sub 3/V, and (Fe,Ni)/sub 3/V.** Marquardt, B.J.; Wert, J.J. (General Electric Co., Aircraft Engine Business Group, 1 Neuman Way, Cincinnati, OH (US)). pp 247-254 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

Several experimental techniques have been implemented in order to compare the tribological response of Ni/sub 2/Al, (Fe,Co)/sub 3/V, and (Fe,Ni)/sub 3/V to commercial engineering alloys. Abrasive and adhesive macrowear behavior during sliding contact has been determined. Microstructural data obtained from transmission electron microscopy (TEM) and scanning electron microscopy (SEM) have been correlated with macrowear results. In this correlation, consideration was given to the effects of wear on long-range-order and the presence of (or absence) of dislocation subcell structures. The formation of dislocation subcell structures is partially related to the material's stacking fault energy (SPE) which has been the basis of recent year theory. An experimentally verified wear mechanism based on inhomogeneous slip is defined.

8218 **Improving properties of P/M steels through liquid phase sintering.** Pickus, M.R. (Univ. of California, Berkeley (USA)). *International Journal of Powder Metallurgy and Powder Technology;* **20**: No. 4, 311-323(1984). Contract AC03-76SF00098.

Steady state liquid phase sintering was utilized to achieve virtually full density in hypereutectoid steels at a temperature of 1175 C. The non-uniform porosity observed in the microstructure of certain liquid phase sintered compacts was accounted for by a proposed liquid phase capillary flow and consequent localized densification. Recommendations are made for avoiding this segregated porosity and were successfully used to prepare high density hypoeutectoid steels by short time transient liquid phase sintering (~ 10 minutes) at a moderate temperature (1175 C). The mechanical properties of these sintered steels are close to commercial wrought steels and much better than commercial P/M steels. A new intermetallic compound based on the copper-manganese-silicon systems had very desirable properties for use in transient liquid phase sintering of ferrous materials. Its melting point is 780 C and tendency to wet iron is remarkable. During heating to the sintering temperature, the compound melts and spreads rapidly over all the surfaces which effectively reduces the diffusion distance to the order of one particle radius. The addition of this new material to iron base powders has a beneficial effect on the sintered density, hardness, tensile and transverse rupture strength. 8 references, 10 figures.

## 3602 Ceramics, Cermets, And Refractories

*REFER ALSO TO CITATION(S) 7539, 8037, 8210, 8216, 8443, 8644, 10162, 10163, 10166, 10168, 10169, 10170, 10171, 10172, 10173, 10174, 10176, 10177, 10178, 10179, 10180, 10181, 10182, 10183, 10184, 10185, 10185, 10186, 10187, 10188, 10189, 10190, 10191, 10196, 10213, 10214, 10215, 10216, 10217, 10218, 10220, 10222, 10223, 10224, 10233, 10467, 10468, 10469, 10470, 10471*

8219 **(AD-A—197069/8/XAB) Transition-metal oxide superconductivity. Technical report.** Dionne, G.F. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 20 Apr 1988. 99p. (TR—802). NTIS, PC A05/MF A01.

Includes errata sheet dated 16 Jun 88.

Superconductivity in transition-metal oxides is discussed from the standpoints of electron-transfer mechanisms and the transition from superconduction to normal conduction. As explanations for the reported superconducting effects, it is suggested that polarons associated with ion pairs of the d9 yields d8 ion combination in 180-degree bond geometries (e.g., Cu(2+) yields Cu(3+) + e(-) ion perovskites) and d1 yields d0 combination in 90-degree geometries (e.g., Ti(3+) yields Ti(4+) + e(-) in spinels) become itinerant within cell boundaries through energy-free electron transfers made possible by strong orbital exchange coupling. The proposed superconduction model is based on continuous linkages between cells that result in moving chains of uniformly spaced charge carriers. A phenomenological theory of normal resistivity and superconduction transition temperature as functions of composition for the La(2-x)Sr(x)$CuO_4$ and $YBa_2Cu_3O(y)$ perovskite families provides excellent agreement with experiment. Reported superconduction and structural data for the related $Bi_2(Sr,Ca)_3Cu_2O(8+y)$ system are also included. Optimized lattice ordering of the sources that produce the mixed-valence Cu(2+)(3+) ions could result in critical temperatures above 300 K.

8220 **(AD-A—197104/3/XAB) Effect of nominal composition on the superconductivity of $La_2CuO$/sub 4-y/. Technical report No. 25, 1 July 1987-15 July 1988.** Fine, S.M.; Greenblatt, M.; Simizu, S.; Friedberg, S.A. (Rutgers--the State Univ., Piscataway, NJ (USA)). 1 Oct 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 36, No. 10, 1 Oct 1987.

Samples of $LaCuO_4$ prepared with a nominal stoichiometry slightly deficient in lanthanum (i.e., La/sub 1.9/$CuO_4$) show a greater diamagnetic susceptibility and a sharper resistive transition than samples prepared from stoichiometric amounts of starting ma-

terials. The effect of adding $K_2CO_3$ to the reaction mixture is also discussed.

8221 **(AD-A—197105/0/XAB) Low-dimensional magnetism in the high T/sub c/ superconductor $LBa_2Cu_3O$/sub 7-y/ (L = Gd, Ho, Er): heat-capacity study. Technical report No. 26, 1 July 1987-15 July 1988.** Simizu, S.; Friedberg, S.A.; Hayri, E.A.; Greenblatt, M. (Rutgers--the State Univ., Piscataway, NJ (USA)). 1 Nov 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 36, No. 13, 7129-7132(1 Nov 1987).

Heat capacities were measured for the high-Tc superconductors $LBa_2Cu_3O$/sub 7-y/ (L = Gd, Ho, Er, Y) between 0.15 and 100 K. While the superconducting phase-transition temperatures of these compounds are nearly the same at Tc = 92 K, the heat-capacity data indicate magnetic ordering in the system of rare earths at Tm = 2.21 K for $GdBa_2Cu_3O$/sub 7-y/ and at Tm - 0.60 K for $ErBa_2CuO$/sub 7-y/. In both cases, the cooperative heat-capacity anomalies, which cannot be attributed to crystalline-field splittings, are found. A semiquantitative fit can be obtained by assuming that two-thirds of the rare earths constitute a 2D Ising system and the rest of them form a 1D Ising-like system. The heat capacity of the $HoBa_2CuO$/sub 7-y/ shows a very flat maximum at approx. 5 K. The separation of the two lowest-lying singlet levels of $Ho^{3+}$ ions is estimated to be approx. 7 K.

8222 **(AD-A—197173/8/XAB) Preparation and characterization of single-crystal $RBa_2Cu_3O$(7-delta) (R = Er, Ho). Technical report No. 31, 1 July 1987-15 July 1988.** Fine, S.M.; Greenblatt, M. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Chemistry). 15 Jul 1988. 19p. NTIS, PC A03/MF A01.

Large (1.5 mm x 1.5 mm x 0.05 mm) single crystals of $RBa_2Cu_3O$(7-delta) (R = Er, Ho) were grown from nonstoichiometric mixtures of $BaCO_3$-$R_2O_3$-CuO. Crystals of $ErBa_2Cu_3O$(7-delta) and $HoBa_2Cu_3O$(7-delta) grown in alumina crucibles have small orthorhombic distortions and are superconducting with resistive Tc (onsets) = 87 K and 80 K respectively. Crystals of $ErBa_2Cu_3O$(7-delta) grown in $ZrO_2$ crucibles show an onset of diamagnetism at 82 K. A number of experiments were carried out in order to optimize the crystal-growth parameters.

8223 **(AD-A—197174/6/XAB) Orthorhombic-to-tetragonal transition in RA(1+x)Ba(2-x)$Cu_3O$(7+ delta) (Re=Nd, Sm, and Eu). Technical report No. 30, 1 July 1987-15 July 1988.** Li, S.; Hayri, E.A.; Ramanujachary, K.V.; Greenblatt, M. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Chemistry). 15 Jul 1988. 21p. NTIS, PC A03/MF A01.

The orthorhombic-to-tetragonal structural phase transition in the high-Tc superconducting oxides of the type R1+xBa2-x$Cu_3O$(7-delta) (R (for rare earth) = Nd, Sm, and Eu) has been investigated using powder x-ray diffraction, dc resistivity, and thermogravimetric techniques. It was found that the orthorhombic-to-tetragonal transition occurs for samples whose nominal stoichiometric content of oxygen is greater than 7.0 (0 delta 0.3) as compared to less than 7.0 in $YBa_2Cu_3O$(7-delta). With increasing (R/Ba) ratio in R1+xBa2-x$Cu_3O$ delta, a clear convergence of multiple orthorhombic peaks to a well-defined single tetragonal peak was observed in the x-ray diffraction pattern. The presence or orthorhombic distortion in this system appears to be essential for achieving 90-K superconductivity.

8224 **(AD-A—197175/3/XAB) Chemistry and high Tc superconductivity in the La-Ba-Cu-O system. Technical report No. 32, 1 July 1987-15 July 1988.** Li, S.; Greenblatt, M. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Chemistry). 15 Jul 1988. 9p. NTIS, PC A02/MF A01.

A systematic investigation of the chemistry and superconductivity in the La-Ba-Cu-O system was carried out, using x-ray powder diffraction, resistivity and TGA measurements. A phase diagram for the La-Ba-Cu-O quasi-ternary system at 950 C was determined, and the relationship between the phases in this system is discussed. A series of A-cation ($ABO_3$-type perovskite) deficient compounds of the type of ($LaBa_2$)x$Cu_3O$/sub 7.0/ (0.67 < x < 0.96) were prepared. Cation deficiencies appear to stabilize the structure but depress Tc. Partial substitution of La and Ba in $LaBa_2CuO$(7+delta) by other rare earth and alkali earth cations, respectively, were also investigated. An enhancement in Tc, compared with La1+x$Ba_2$-x$Cu_3O$(7+delta) was found in $LaBa_2$-xCax$Cu_3O$(7+delta) (0 < x , 1.0), providing further evidence for the importance of reduced lattice dimensions in stabilizing the superconducting phase of La-123.

8225 **(AD-A—197176/1/XAB) Effects of fluorination on the 90 K superconductor $Ba_2RCu_3O$(7-delta) (R=Y,Eu; 0< delta <1). Technical report No. 29, 1 July 1987-15 July 1988.** Zahurak, S.M.; Fine, S.M.; Murphy, D.W.; Greenblatt, M.; Nakahara, S. (Rutgers--the State Univ., New Brunswick, NJ (USA)). 15 Jul 1988. 14p. NTIS, PC A03/MF A01.

Sintered pellets of $Ba_2RCu_3O$(7-delta) (R= Y,Eu; 0 < or = delta < or = 1) were allowed to react with fluorine gas at temperatures between 200 and 300 C. Fluorination of $Ba_2YCu_3O$6.92 affords a nominal composition of $BaYCu_3O$6.4F1.3 and Tc(onset) = 92K. Fluorination of $Ba_2YCu_3O$6.15 gives a nominal composition of $Ba_2YCu_3O$4.7F3.0, which is not superconducting to 4.2K. Fluorinated pellets appear to be single-phase as determined by x-ray powder diffraction. However, Raman, NQR, ESR, x-ray diffraction, and TEM data suggest that fluorine is not incorporated into the superconducting phase, but rather is incorporated into a secondary amorphous phase. Barium, Copper oxides.

8226 **(AD-A—197229/8/XAB) High-temperature superconducting films by sol-gel preparation. Technical report, 1 July 1987-15 July 1988.** Nagano, M.; Greenblatt, M. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Chemistry). 15 Jul 1988. 12p. NTIS, PC A03/MF A01.

Superconducting oxide $YBa_2Cu_3O$(7-delta) was prepared by a sol-gel method, using nitrates or organometallic compounds as the starting reagents and ethylene glycol as the solvent. The processing parameters for gelation and pyrolysis were investigated. Single phase $YBa_2Cu_3O$(7-delta) was obtained when the as-prepared gel was heated above 900C in air. Films were prepared by painting the gels on various substrates. The best superconducting films were obtained when the as-prepared gels were heated up to 950C and annealed at 800C on single crystals of SrTiO3 and at 550C on yttrium-stabilized $ZrO_2$(YSZ)in $O_2$, respectively. Films with Tc(zero)= 85K were obtained on the(100)surface of single-crystal $SrTiO_3$; oriented films with Tc(zero)= 82K on the(100)surface of YSZ formed. The films obtained from organic precursors showed Tc(onset)approx. 90K; however, Tc(zero)was lower(approx. 50K)than those of the films formed from nitrates.

8227 **(AD-A—197359/3/XAB) Boron-nitride preceramic polymer studies. Technical report.** Paciorek, K.J.; Kratzer, R.H. (Ultrasystems Defense and Space Systems, Inc., Irvine, CA (USA)). 22 Feb 1988. 21p. (TR—7). NTIS, PC A03/MF A01.

Boron nitride fibers and boron nitride coatings on alumina fibers are described. The boron nitride fibers were obtained from fusible preceramic polymer. For the coatings, a non-fusible, organic-solvent-soluble, preceramic polymer was utilized. Transformation of the preceramic polymers to boron nitride ceramic was accomplished in an ammonia atmosphere. The fully cured ceramics are colorless and do not undergo weight or shape changes when heated to 1000 C in nitrogen or air.

8228 **(AD-A—197383/3/XAB) Overview of high-temperature superconductivity: theory, surfaces, interfaces, and bulk systems. Technical report.** Sahu, D.; Langner, A.; George, T.F.; Weaver, J.H.; Meyer, H.M. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Jun 1988. 23p. (UBUFFALO/DC—88/TR-75). NTIS, PC A03/MF A01.

An overview of the theoretical and experimental aspects of the recently discovered superconducting compounds is presented. This overview is divided into three sections. The first section reviews some of the theoretical and computational works under the subsections entitled pairing mechanisms, electronic-structure calcu-

lations, and thermophysical properties. In the second section, surface and interface-chemistry issues related to the fabrication and use of high-temperature superconductors for high-performance applications are presented. Specific issues discussed include metallization and the formation of stable ohmic contacts, and chemically-stable overlayers that are suitable for passivation, protection, and encapsulation of superconducting material structures that can then be used under a wide range of environmental conditions. Lastly, issues are discussed that are related to each of the bulk high-temperature superconducting ceramic oxides which have received so much attention the past two years. These include $Tl_2Ba_2Ca_2Cu_3O_{10}$ with a critical temperature of 125 K, which is the current record.

8229 **(AD-A—197415/3/XAB) Phosphorus-containing derivatives of decaboranes(14) as precursors of boron-containing materials. Technical report.** Rees, W.S. Jr.; Seyferth, D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 25 Jun 1988. 27p. (TR—26). NTIS, PC A03/MF A01.

Ceramic materials whose properties are attractive for high-technology applications often fail to realize their full potential of usefulness due to an inability to be fabricated into complex, durable shapes. One such class of materials is that of the boron-containing ceramics, e.g., boron carbide, boron nitride, boron phosphides, aluminum boride, and boron silicides. The authors report the results of an effort to extend the use of preceramic polymers to boron-containing materials. The motivation for this work was to utilize processable materials which give, in general, boron carbide as the major ceramic phase upon pyrolysis. A route to soluble boron-containing polymers has been developed. The synthesis and characterization of phosphorus-containing monomeric and polymeric derivatives of decaborane ($B_{10}H_{14}$) are given. Preparation and characterization of boron-containing ceramic materials from these molecular and macromolecular species are discussed. Success was achieved in the areas of ceramic-fiber and monolith production and in the area of binder applications for composites of advanced ceramic materials.

8230 **(AD-A—197422/9/XAB) Preparation of the high-Tc superconductor $YBa_2Cu_3O(7-x)$ using organometallic precursors. Technical report.** Interrante, L.V.; Jiang, Z.; Larkin, D. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemistry). 21 Jul 1988. 18p. (TR—3). NTIS, PC A03/MF A01.

Organic soluble precursors to the high Tc 1-2-3 superconductor, $YBa_2Cu_3O7-x$, were prepared using polyesters derived from the interaction of citric acid (CA) or ethyl-enediaminetetraacetric acid (EDTA) with ethylene glycol. Mixtures of the nitrate, carbonate and/or acetate salts of the three metal ions with CA or EDTA and ethylene glycol were heated to obtain homogeneous green solids containing the desired 1:2:3 ratios of $Y^{3+}$, $Ba^{2+}$, and $Cu^{2+}$ ions. Pyrolysis at 850C-960C in oxygen gave the superconducting, orthorhombic, $YBa_2Cu_3O7-x$ phase. Films of the superconductor were prepared by dropping ethylene glycol solutions of these precursors onto zirconia and alumina substrates, followed by pyrolysis to 950 C in $O_2$. The results of TGA/DSC and FTIR studies of these precursors, as well as XRD, FTIR, pyrolysis/GC, electrical and magnetic-property measurements on the pyrolysis products are presented and discussed in the context of the probable precursor structures and pyrolysis chemistry.

8231 **(AD-A—197513/5/XAB) Thermomechanical contact phenomena and wear of sliding-seal components. Annual report, 1 January-31 December 1987.** Kennedy, F.E.; Espinoza, B.M.; Pepper, S.M. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 30 Mar 1988. 40p. NTIS, PC A03/MF A01.

The objectives of this investigation were to better understand the tribological behavior of ceramic-coated rings sliding against carbon graphite and the thermocracking that occurs with some of the ceramic coatings. Sliding wear tests were conducted on Inconel 625 substrates coated with four different hard materials: chromium oxide, chromium carbide, titanium nitride, and tungsten carbide. Tests were also run to determine the corrosion behavior of the ceramic-coated rings in seawater. Surface profilometry, mass loss measurements, and microscopy were used to characterize wear, cracking and corrosion phenomena. Coupled with the experimental work was a theoretical analysis of temperatures and stresses in the contact region of the ceramic coating during sliding. The influence of various material and geometric parameters on coating cracking was studied in the analytical work.

8232 **(AD-A—197686/9/XAB) Tunneling microscopy of superconductors and tunneling barriers. Annual report, 1 June 1987-31 May 1988.** De Lozanne, A. (Texas Univ., Austin (USA). Dept. of Physics). 31 May 1988. 11p. NTIS, PC A03/MF A01.

Thin films of high-temperature superconductors were made by sputtering and by co-evaporation. The former method produced thin films of YBaCuO which were completely superconducting at 82 K with 6 K transition widths. A new method was developed at the University of Texas which produced films of YBaCuO on strontium titanate that were superconducting at 84 K. This method minimizes the process temperature and produces films that are superconducting without the need for annealing. The films were also grown on silicon and sapphire substrates with zero resistance of 68 K or better. A low-temperature scanning tunneling microscope was used to study the superconducting properties of these and other samples. High quality spectroscopic data was obtained which yields a value of approximately 11 for the ratio of the superconducting gap to the transition temperature.

8233 **(AD-A—197763/6/XAB) Determination of the homogeneity range of $La_2CuO_4$. Technical report.** DiCarlo, J.; Niu, C.M.; Dwight, K.; Wold, A. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 25 Jul 1988. 10p. (TR—15). NTIS, PC A02/MF A01.

Pure $La_2CuO_4$ was prepared by decomposition of the nitrates followed by an oxygen anneal at 500 C and 600 psi of oxygen. The extent of anion vacancies was studied by thermogravimetric analysis, x-ray diffraction, and magnetic susceptibility. The magnitude of this deficiency is less than can be unambiguously ascertained by direct thermogravimetric analysis, which has a limit in accuracy in x of 0.1 for the composition LA2CuO4-x. However, significant shifts in the Neel temperatures confirmed the variation in anion vacancy concentrations. Attempts to modify the cation ration of La:Cu = 2:1 failed to yield single phase material.

8234 **(AD-A—197819/6/XAB) Electronic properties and current-carrying capacity of high-temperature ceramic superconductors. Final report.** Jones, T.E.; McGinnis, W.C.; Boss, R.D.; Jacobs, E.W.; Schindler, J.W. (Naval Ocean Systems Center, San Diego, CA (USA)). Jul 1988. 11p. (NOSC/TD—1306). NTIS, PC A03/MF A01.

Samples of both the $YBa_2Cu_3O_7$ family of high-temperature ceramic superconductor and the layered set of bismuth based superconductors, described by the set of crystal structures $Bi_2Sr_2Ca(n-1)CunO(2n+4+delta)$, were synthesized and characterized by x-ray diffraction, and temperature dependent resistivity and thermoelectric-power measurements. Superconductivity in the yttrium-based materials is relatively insensitive to rare earth substitutions for the yttrium. Critical-current measurements on these materials reveal two characteristic critical current values. The intrinsic critical current, determined by the suppression of the transition midpoint, is estimated to be greater than 10,000 A/sq cm at 77K. The critical current defined by the R=0 point is much less in bulk ceramics and limited by intercrystalline weak links. For the bismuth-based materials, two high-temperature superconducting phases were observed with transition temperatures near 80 and 110 K. Evidence from thermorelectric power measurements is presented which shows both electron-like and hole-like carriers contribute to the electrical transport in this family of ceramic superconductors. However, all of superconducting transitions observed involve with transition temperatures near 80 and 110 K. Evidence from thermoelectric power measurements is presented which shows both electron-like and hole-like carriers contribute to the electrical transport in this family of ceramic supercondutors. However, all of the superconducting transitions observed involve hole-like states.

8235 **(AD-A—197889/9/XAB) Synthesis and processing of ceramic superconductors. Final report, 1 July 1987-1 July 1988.** Cima, M.J.; Rhine, W.E.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge (USA). Materials Processing Center). Jul 1988. 43p. NTIS, PC A03/MF A01.

This report includes these topics: Synthesis and Processing of Ceramic Superconductors, Powder Processing for Microstructural Control in Ceramic Superconductors, $Ba_2YCu_3O6.9$ Powder Preparation by Sol-Gel Emulsion Techniques, Magnetic Inducement of Texture in $Ba_2YCu_3O6.9$ Particle Assemblies Under Cryogenic Conditions, Reaction of $Ba_2YCu_3O6.9$ Films with Yttria-Stabilized Zirconia Substrates, and Synthesis of $Ba_2YCu_3O6.9$ Powder.

8236 **(AD-A—198375/8/XAB) Study of high temperature failure mechanisms in ceramics. Final report, 1 April 1985-31 March 1988.** Page, R.A.; Lankford, J. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Materials Sciences). Jun 1988. 68p. (SWRI—8578/5). NTIS, PC A04/MF A01.

This report summarizes the results of a fundamental study involving experimental characterization and analytical modeling of grain-boundary cavitation and creep crack growth in structural ceramics exposed to pure tensile loading. The major experimental techniques employed in the program are the use of small-angle neutron scattering to characterize cavity nucleation and growth and stereo-imaging analysis to characterize the stress and strain fields associated with growing creep cracks. The major accomplishments described in the report include the design, construction, and successful testing of a creep apparatus that permits creep testing of ceramics under pure tensile loading, the determination of surface-preparation conditions that are adequate for the stereo-imaging analysis, and the conduct of a series of creep tests designed to characterize the kinetics of damage accumulation under pure tensile loading.

8237 **(AD-A—198404/6/XAB) New mechanism for superconductivity.** Dewar, M.J. (Texas Univ., Austin (USA). Dept. of Chemistry). Dec 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Angewandte Chemie, Vol. 26, No. 12, 1273-1275(Dec 1987).

The recent discovery of high-temperature superconductivity in certain mixed copper oxides has aroused much attention, not only because of possible practical applications but also because it cannot easily be explained in terms of the conventional Bardeen-Copper-Schrieffer (BCS) mechanism. Here, a radically different alternative is suggested, based on electron hopping between atoms of a metal in two different valence states under the control of two cooperating lattice vibrations. Other interpretations have involved variants of BCS theory, being likewise based on the conventional band theory of solids and electron-phonon coupling. The mechanism suggested here postulates a strong coupling between pairs of lattice vibrations and electron hopping, leading to a breakdown of the Born-Oppenheimer approximation in a manner reminiscent of that involved in the Jahn-Teller effect. Such a situation cannot be discussed in terms of conventional band theory because this rests on the Born-Oppenheimer approximation. While the possibility that electron hopping might be involved in these new materials has been recognized, the essential feature of the mechanism suggested here is novel.

8238 **(AD-A—198754/4/XAB) Processing of mixed-oxide superconductors.** Campbell, A.M.; Ashby, M.F. (Cambridge Univ. (UK). Dept. of Engineering). 1987. 35p. NTIS, PC A03/MF A01.

High-Tc superconductivity has continued to change at a rapid pace. Since the last report, two new compounds have been reported with even higher critical temperatures and possibly higher critical currents. Less encouraging is a recent experiment reported from IBM from which it appears that even clean low-angle grain boundaries can limit the current densities. If confirmed, this means that in future all practical conductors will have to consist of carefully aligned grains, probably melted in some way to fuse the boundaries together. Fortunately, all the techniques developed in this project are applicable to a wide range of mat. rials, but the authors have decided to postpone any more HIPing until they have prepared better orientated samples. Most of the work is described in three enclosed papers, and only the main conclusions are summarized in this report.

8239 **(AD-A—198780/9/XAB) Liquid phase sintering of carbides using a nickel-molybdenum alloy. Final report.** Barranco, J.M.; Warenchak, R.A. (Army Armament Research, Development and Engineering Center, Watervliet, NY (USA). Benet Labs.). Jul 1988. 38p. (ARCCB-TR—88031). NTIS, PC A03/MF A01.

Liquid-phase vacuum sintering was used to densify four carbide groups. These were titanium carbide, tungsten carbide, vanadium carbide, and zirconium carbide. The liquid phase consisted of nickel with additions of molybdenum from 6.25 to 50.0 wt.% at doubling increments. The liquid phase or binder compromised 10, 20, and 40 wt.% of the pressed powders. The specimens were tested using three-point bending.

8240 **(AD-A—198988/8/XAB) Synthesis and characterization of BiCaSrCuO and BiSnCaSrCuO superconducting ceramics. Technical report.** Miller, J.H. Jr.; Hatfield, W.E.; Rohrs, B.R.; Kirk, M.L.; Perkinson, J.L. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 20 Sep 1988. 10p. (TR—32). NTIS, PC A02/MF A01.

Magnetic-susceptibility measurements, resistance measurements, Rutherford backscattering, scanning electron microscopy, and energy-dispersive X ray analyses were utilized in order to determine the effects of composition and firing conditions on the properties of the Bi-Ca-Sr-Cu-O superconducting ceramics.

8241 **(AD-A—199104/1/XAB) Chemical compatibility of high-TC superconductors with other materials. Technical report No. 12, August 1987-July 1988.** Williams, R.S.; Chaudhury, S. (California Univ., Los Angeles (USA)). 22 Jul 1988. 14p. NTIS, PC A03/MF A01.

In any application, the new oxide superconductors will have to coexist in intimate contact with other materials. However, the copper-oxygen bonds common to all presently known oxide superconductors with Tc above 40K are relatively weak. This means that elements that form much stronger bonds with oxygen, such as Si, will be chemically unstable when in contact with the copper-oxide superconductors. This paper establishes procedures and guidelines that will enable workers to choose materials that will not react chemically with the oxide superconductors. These should enable researchers working in all applications areas to avoid unnecessary empirical searches for suitable substrate or host materials by eliminating the most thermodynamically unfavorable choices. In particular, the authors determined which of the elemental metals should be most stable in contact with the copper-oxide semiconductors, and examined schemes for integrating these superconductors into Si devices.

8242 **(AD-A—199209/8/XAB) Photogeneration of self-localized polarons in $YBa_2$ $Cu_3O_7$-delta and $La_2$ $CuO_4$. Technical report.** Kim, Y.H.; Foster, C.M.; Heeger, A.J.; Cox, S.; Acedo, L. (California Univ., Santa Barbara (USA). Dept. of Chemistry). Aug 1988. 16p. (TR—25). NTIS, PC A03/MF A01.

Photoinduced infrared absorption measurements of $YBa_2Cu_3O_7$-delta (delta=0.75) and $La_2CuO_4$ are reported. The authors observed photoinduced infrared active vibrational modes and associated phonon bleachings which indicate the formation of a localized structural distortion in the Cu-O plane around the photogenerated carriers. In both materials, an associated electronic transition indicates that this structural distortion causes the formation of a self-localized electronic state in the energy gap. The photoinduced distortion and the associated self-localized gap state demonstrate that the photoexcitations are relatively long-lived polarons (or bipolarons). The dynamic mass associated with the distortion is smaller in $YBa_2Cu_3O_7$-delta than in $La_2CuO_4$ (smaller dynamic mass implies a longer range distortion). Since these features are not observed in the isostructural compound, $La_2NiO_4$, we suggest that polaron (or bipolaron) formation may play an important role in the high temperature superconductivity.

8243 **(AECL—8062) Colloid chemistry and its application to the production of recycled fuels by sol gel processes.** Turner, C.W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1986. 67p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88704979/JAW.

This report tries to bridge the gap between the practical application and the underlying chemistry of sol gel processes as they apply to the production of ceramic nuclear fuel. The relevant principles of colloid chemistry are discussed to provide a suitable background from which to review nearly 25 years of development of sol gel technology in the nuclear industry. The two components of a sol gel process, sol formation and gelation, are discussed separately as well as a process known as gel precipitation that can be used to gel either sols or solutions. A process is identified that appears to be the most suited to the demands of remote fabrication. 40 refs.

8244 **(ANL—87-52) X-ray computed tomography for nondestructive evaluation of advanced structural ceramics.** Ellingson, W.A.; Vannier, M.W. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 61p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89002075/JAW.

This report characterizes the current status of x-ray computed tomography (CT) as applied to the nondestructive evaluation of ceramic materials. The principal advantages of x-ray CT scanning are two. The first is the capability to produce high-contrast, geometrically accurate digital pictures (images) of slices through an object with a reasonably high spatial resolution. The second is that these slice images are not influenced to any significant degree by overlap or by structures outside of the plane of section (the tomographically imaged plane). Conventional radiography offers neither of these advantages. 34 refs., 42 figs., 4 tabs.

8245 **(BNL—41917) Interaction of CO, $CO_2$ and $H_2O$ with Ba and $YBa_2Cu_3O_7$.** Qiu, S.L.; Lin, C.L.; Ruckman, M.W.; Chen, J.; Chen, D.H.; Xu, Y.W.; Moodenbaugh, A.R.; Strongin, M.; Nichols, D.; Crow, J.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-881002—25). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003160/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Photoemission from high Tc superconductors crucially depends on surface stoichiometry as well as the interaction of impurities with the reactive surface. In this paper we discuss the photoemission spectra of clean $YBa_2Cu_3O_7$ and $YBa_2Cu_3O$/sub 6.25/ as well as the spectra after the interaction of CO, $CO_2$ and $H_2O$ with both the high Tc 1-2-3 compound and Ba metal. 13 refs., 6 figs.

8246 **(CONF-880408—42) Studies of NiO-metal interfaces.** Merkle, K.L.; Shao, B. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003634/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, United States (4 Apr 1988).

Transmission electron microscopy techniques were applied to investigate the structure of interfaces between noble metals and NiO. Interfaces between NiO and Pt or Cu were formed by diffusion bonding. NiO and Cu form aligned lattices, while no unique topotactical relationship was found for the NiO-Pt interfaces. Internal reduction of (Ni, Cu)O was also used to investigate NiO-Cu interfaces at polyhedral Cu precipitates in a NiO matrix. The morphology and compositions of precipitates was studied for several reduction treatments. The formation of largely (111) interfaces during solid state reduction suggests that these planes of densest packing are associated with the lowest interfacial free energy. The quite large lattice mismatch is accommodated by misfit dislocations as observed by HREM. 5 refs., 7 figs.

8247 **(CONF-880504—9) Microstructure evolution in microwave sintered alumina.** Janney, M.A.; Kimrey, H.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004186/JAW.

From 90. annual meeting of American Ceramic Society; Cincinnati, OH, USA (1 May 1988).

Comparisons were made of sintering rate, apparent activation energy, surface area, and pore size distribution for alumina sintered in a quasi-optical microwave furnace at 28 GHz and alumina sintered in a conventional tungsten element furnace. The sintering rates for microwave firing were much higher. The apparent activation energy for microwave sintering was about one-third that of conventional sintering. Pore size at a given density was larger for the microwave sintered samples. It is suggested that microwave firing may enhance densification relative to coarsening in sintering. 6 refs., 7 figs.

8248 **(CONF-881002—28) Cross-sectional transmission electron microscopy of the interfaces between PVD TiNx coatings and steel substrates.** Erdemir, A.; Cheng, C.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 22p. NTIS, PC A03. Order Number DE89003631/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

The functional lifetime of surface coatings for mechanical, tribological and metallurgical applications is strongly related to their structural and interfacial characteristics. In this study, cross-sectional transmission electron microscopy (XTEM) and electron energy loss spectroscopy (EELS) were concurrently employed to investigate the structural and chemical states of the TiN films and interfaces formed during sputter deposition and ion plating. The effects of deposition temperatures and process on the solid state interactions between the film and substrate materials are reported. In addition, convergent beam electron diffraction studies as well as previously reported Auger depth profile results were incorporated in the present study to assist in interpreting the XTEM observations. The results show that exposure to high temperatures during ion plating strongly influences the microstructural as well as chemical states of the TiN films and the film-substrate interfaces. 15 refs., 3 figs.

8249 **(CONF-881125—4) Exploratory high-temperature tensile and cyclic fatigue characterization of commercial mg0-PSZ.** Liu, K.C.; Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03 - OSTI. Order Number DE89004169/JAW.

From 3. international symposium on ceramic materials and components for engines; Las Vegas, NV, USA (27 Nov 1988).

Monotonic tensile fast fracture and tension-tension cyclic fatigue tests were performed on a commercial grade of MgO partially stabilized zirconia (MgO-PSZ) at room and elevated temperatures. Test results were analyzed and correlated as to strength, temperature, fatigue lifetime, and compared with (MOR) data when possible. Results showed that because of failure to incorporate phase transformation-induced plasticity, the MOR values were generally much higher than the true tensile strength in flexure. Fractographic examinations were made to study the fracture modes and failure origins of fracture initiation sites. The information was then used to calculate the critical fracture toughness based on the Griffith-Irwin theory. Comparisons of the calculated and available data showed reasonable agreement in some situations, but not in general. Limited test data obtained at temperatures above 800{degree}C showed that tension-tension cyclic loading from low to high stress in increasing multiple steps raised the fatigue strength of the material above the monotonic uniaxial tensile strength. 12 refs., 13 figs., 2 tabs.

8250 **(DOE/ER/13732—1) Synthesis and properties of new preceramic materials: Progress report, June 1, 1987--November 30, 1988.** Sneddon, L.G. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). Aug 1988. Contract FG02-87ER13732. 10p. NTIS, PC A02 - OSTI. Order Number DE89003436/JAW.

The development of new methods for the production of complex materials is one of the most important problems in modern solid state chemistry and materials science. This project is attempting to apply the synthetic principles which have evolved in inorganic and organometallic chemistry to the production of important non-oxide ceramics, such as boron nitride, boron carbide and metal borides. The synthetic approach is focusing on the use of transition

metal catalysts to induce transformations in molecular boron-hydrogen compounds leading to the formation of useful preceramic materials. Our recent work has now resulted in the production of several new polymer systems, including poly(vinylborazine) and poly(vinylpentaborane), which have proven to be high yield precursors to boron nitride and/or boron carbide. Current work is now directed toward the synthesis of new types of molecular and polymeric boron-containing species and an exploration of the solid state properties of the ceramics which have been produced in these studies. 2 figs.

8251 **(INIS-BR—1358) Electron and nuclear magnetic resonances in compounds and metallic hydrides.** Brasil Filho, N. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). Nov 1985. 119p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705156/JAW.

Proton pulsed Nuclear Magnetic Resonance measurements were performed on the metallic hydrides ZrCr/sub 2/H/sub x/ (x = 2, 3, 4) and ZrV/sub 2/H/sub y/ (y = 2, 3, 4, 5) as a function of temperature between 180 and 400K. The ultimate aim was the investigation of the relaxation mechanisms in these systems by means of the measurement of both the proton (/sup 1/H) spin-lattice (T/sub 1/) and spin-spin (T/sub 2/) relaxation times and to use these data to obtain information about the diffusive motion of the hydrogen atoms. The diffusional activation energies, the jump frequencies and the Korringa constant, C/sub k/, related with the conduction electron contribution to the /sup 1/H relaxation were determined for the above hydrides as a function of hydrogen concentration. Our results were analysed in terms of the relaxation models described by Bloembergen, Purcell and Pound (BPP model) and by Torrey. The Korringa type relaxation due to the conduction electrons in metallic systems was also used to interpret the experimental results. We also present the Electron Paramagnetic Ressonance (EPR) study of Gd/sup 3+/, Nd/sup 3+/ and Er/sup 3+/ ions as impurities in several AB/sub 3/ intermetallic compounds where A = LA, Ce, Y, Sc, Th, Zr and B = Rh, Ir, Pt. The results were analysed in terms of the multiband model previously suggested to explain the behaviour of the resonance parameter in AB/sub 2/ Laves Phase compounds.

8252 (INIS-mf—11860, pp 123-134) **/sup 57/Fe Moessbauer studies of hydrides and deuterides of vanadium and niobium.** Wagner, F.E.; Wordel, R.; Zelger, M. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The systems V-H, V-D, Nb-H and Nb-D were studied by Moessbauer spectroscopy, with /sup 57/Fe foreign atoms inserted as diluted substitution probes. Measurements were effected within a temperature range of 6 to about 400 K, with metal-hydrogen ratios between 0.5 and 1.6. The essential results obtainable therefrom consist in information on the dynamic behaviour of hydrogen in the neighbourhood of probe atoms, in particular on retention times and on the extent of the hydrogen-induced lattice distortions which lead to a quasi-elastic element in the Moessbauer resonance. The results permit the verification of model conceptions of the elasticity of hydrogen and of blocking effects. Isotope effects occur particularly in vanadium, but a lesser degree of the influence of isotopes on the phase transition temperatures has also been registered in Nb-H and Nb-D. The interaction between foreign atoms and hydrogen was studied in swelling tests as well as in absorption tests. It can be seen that Fe in the hydrides and deuterides of vanadium is slightly antitrapping, whereas in the case of Fe and Co in the Nb-H and Nb-D systems, neither an attractive nor a repulsive interaction with the interstitial atoms is provable.

8253 (INIS-mf—11860, pp 222-230) **Thermodynamic and magnetic measurements in the supercritical field of palladium hydride and -deuteride.** Wicke, E.; Blaurock, J. (Muenster Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8254 **(LA-UR—88-3413) Photoemission from single-crystal $EuBa_2Cu_3O_{6+x}$ cleaved below 20K: Metallic-to-insulating surface transformation.** List, R.S.; Arko, A.J.; Fisk, Z.; Cheong, S.W.; Conradson, S.D.; Thompson, J.D.; Pierce, C.B.; Peterson, D.E.; Bartlett, R.J.; O'Rourke, J.A. (Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA); Ames Lab., IA (USA); Argonne National Lab., IL (USA)). 1988. Contract W-7405-ENG-36;AC02-76CH00016;AC04-76DP00789;W-7405-ENG-82. 7p. (CONF-881035—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002237/JAW.

From Topical conference on high-{Tc} superconducting thin films, devices, and characterization; Atlanta, GA, USA (3 Oct 1988).

Valence band ultraviolet photoemission spectra (UPS) of single-crystal $EuBa_2Cu_3O_{6+x}$ ($x > 0.6$) samples cleaved in vacuum at 20 K demonstrate that the metallic superconducting phase undergoes an irreversible transformation via near-surface oxygen loss to an insulating state upon annealing above 50 K. Freshly cleaved surfaces at 20 K exhibit a density of states at the Fermi level comparable to that of copper, and have both O(2p) and Cu(3d) character at E/sub F/ based on the photon energy dependence of the intensity. Reasonably good agreement between band structure calculations and the present data would suggest theoretical models using the band state as a starting point. 18 refs., 2 figs.

8255 **(LA-UR—88-3776) Mechanical characterization of SiC whisker-reinforced $MoSi_2$.** Carter, D.H.; Gibbs, W.S.; Petrovic, J.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-881125—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003486/JAW.

From 3. international symposium on ceramic materials and components for engines; Las Vegas, NV, USA (27 Nov 1988).

The mechanical characteristics of an intermetallic matrix with two different reinforcements were studied. The matrix material was $MoSi_2$, with either Los Alamos VLS SiC whiskers or Huber VS SiC whiskers. The purpose of the reinforcement was to provide toughening at ambient temperature and strengthening at elevated temperatures. The VLS whiskers greatly improved the yield strength of the matrix at 1200{degree}C, and also increased the room temperature fracture toughness of the matrix. The VS whiskers were added because they are much smaller in length and diameter, and therefore decreased the mean free path between whiskers, at the same volume fraction. The VS whiskers improved the toughness of the matrix at ambient temperature, and increased the yield strength of $MoSi_2$ at 1400{degree}C by 470%. The high strength of this new composite places this material in the realm of attractive engineering materials for high-temperature applications. 11 refs., 6 refs., 1 tab.

8256 **(LA-UR—88-3864) Shock consolidation of $YBa_2Cu_3O_{7-x}$ powders.** Staudhammer, K.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-881060—4). NTIS, PC A03 - OSTI. Order Number DE89003582/JAW.

From HERAPS '88: international seminar on high energy working of rapidly solidified materials; Novosibirsk, USSR (10 Oct 1988).

Yttrium-Barium-Copper Oxide ceramics, commonly known as Y-123, have been shock compacted by numerous investigators. Unfortunately most of them, initially, had not succeeded in obtaining crack/melt-free monoliths. What is now known from these and similar efforts is that the shock pressure must be low and that the temperature excursion due to the shock and related strains be minimized and kept below the decomposition temperature of the Y-123 compound. This paper describes the efforts and considerations in some of the shock work performed at Los Alamos National Laboratory. 12 refs., 8 figs., 1 tab.

8257 **(LBL—25225) Pore drag in alumina.** Roedel, J.; Glaeser, A.M. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 16p. (CONF-8805228—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002956/JAW.

From International symposium on processing of advanced ceramics; Cincinnati, OH, USA (1 May 1988).

A model experiment is introduced that allows the study of pore drag and pore-boundary separation under conditions of constant density. Photolithography, ion beam etching, and hot pressing were used to generate microdesigned interfacial pore arrays, consisting of pores of controlled size and spacing, in alumina. Results from an investigation of pore drag suggest that the surface diffusivity in MgO-doped alumina exceeds that in undoped alumina by a factor of 2–9 at 1600{degree}C. The condition for pore-boundary separation was found to depend strongly on pore spacing; the influence zone of pores is several microns wide. Concurrent studies of the grain boundary mobility show that the migration rate of basal plane sapphire into undoped alumina is lower than that into MgO-doped alumina. 22 refs., 10 figs.

8258 **(LBL—26047) Theory and experiments for isothermal and non-isothermal sintering.** Searcy, A.W.; Beruto, D. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 29p. (CONF-8709180—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002945/JAW.

From Superconducting ceramics; Canterbury, UK (10 Sep 1987).

New formulations of thermodynamics for surfaces and for non-isothermal systems are used as a basis for analyzing the kinetics of isothermal and non-isothermal sintering. The analysis suggests: (1) rates of microstructural changes in crystalline aggregates sometimes are limited by layer growth instead of diffusion; (2) temperature gradients can drive microstructural changes in aggregate; and (3) surface diffusion over distances much greater than particle diameters can promote densification and/or coarsening. Isothermal experiments with aggregates of very small CaO and MgO crystals suggest that coupled pore and grain growth can be a dominant process from the initiation of sintering. Densification studies with isothermal and non-isothermal aggregates confirm a significant effect of temperature gradients. Deductions from the theory and experiments are compared to observations of others. 47 refs., 5 figs.

8259 **(MLM—3556) Chemistry of glass-ceramic to metal bonding for header applications: 4, Effect of treatments on multicomponent lithia/alumina/silica glass-ceramic.** Kramer, D.P.; Moddeman, W.E. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 30 Nov 1988. Contract AC04-88DP43495. 23p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004432/JAW.

Auger electron spectroscopy (AES) and electron spectroscopy for chemical analysis (ESCA) were used to study the surface of a multicomponent lithia/alumina/silica glass-ceramic as a function of surface treatment. The glass-ceramic specimens were processed in the same manner as is presently being used in the manufacturing of glass-ceramic headers. The processing steps involve four-step solvent cleaning, sealing at high temperature, and oxide removal. At each step in the process, glass samples were studied with AES and ESCA to determine their resultant elemental surface composition and film thickness. In addition, the effect of a final plasma cleaning operation on the glass surface was also examined. The results show that the type, concentration, and thickness of surface species are dependent on the processing technique. 1 ref., 4 figs., 6 tabs.

8260 **(N—88-28981) High temperature creep deformation of $Si_3N_{4-6}Y_2O_3$-$^2Al_2O_3$.** Todd, J.A.; Xu, Z.Y. (University of Southern California, Los Angeles (USA)). 1988. 32p. (NASA-CR—183204; NAS—1.26:183204). NTIS, PC A03/MF A01.

The creep properties of silicon nitride containing 6 wt percent yttria and 2 wt percent alumina have been determined in the temperature range 1573 to 1673 K. The stress exponent, n, in the equation epsilon dot varies as sigma sup n, was determined to be 2.00 + or - 0.15 and the true activation energy was found to be 692 + or - 25 kJ/mol. Transmission electron microscopy studies showed that deformation occurred in the grain boundary glassy phase accompanied by microcrack formation and cavitation. The steady state creep results are consistent with a diffusion controlled creep mechanism involving nitrogen diffusion through the grain boundary glassy phase.

8261 **(PB—88-251962/XAB) Electronic structure and magnetism in $La_2NiO_4$.** Guo, G.Y.; Temmerman, W.M. (Daresbury Lab. (UK)). Jul 1988. 13p. (DL/SCI/P—594T). NTIS, PC E03/MF E03.

Selfconsistent spin-polarized electronic-band structure calculations have been performed for $La_2NiO_4$ in its nonmagnetic, ferromagnetic, and antiferromagnetic states. The principal results are: the band structure of nonmagnetic tetragonal $La_2NiO_4$ is similar to the isostructural $La_2CuO_4$, but with two Ni-O antibonding bands and also a higher density of states at the Fermi level; the ground state is found to be an antiferromagnet with a spin moment of about 0.8 (mu sub B)/Ni; no ferromagnetic solution is obtained for lattice constants within 5% of the experimental value. The electronic properties of the $La_2NiO_4$ compounds and the nature of the tetragonal-orthorhombic phase transition in both $La_2CuO_4$ and $La_2NiO_4$ are discussed in view of these results.

8262 **(PB—88-253414/XAB) Hot-corrosion resistance of $ZrO_2$ ceramics to molten salt.** Ono, S.; Yamamoto, H.; Tsunoda, H.; Motomura, H. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1988. 6p. NTIS, PC E05/MF A01.

Text in Japanese; Included in Mitsubishi Juko Giho, Vol. 25, No. 3, 230-235(1988).

PSZ ceramics are promising materials for new energy systems because of its superior mechanical properties. The study is an evaluation of the effects of molten salt on the corrosion behavior of PSZ (3 mol % $Y_2O_3$-PSZ). The resistance of PSZ against corrosion by $Na_2SO_4$, $V_2O_5$ and their mixture was studied by holding PSZ samples in salt powder at a temperature of 1200°C for 100 hours. It was found that the corrosion resistance of PSZ against $Na_2SO_4$ is excellent. In the case of using $V_2O_5$, PSZ is chemically attacked and the corrosion rate of PSZ is over 40% (weight loss). The microstructure of the PSZ test piece in the outer part after the corrosion test shows a tetragonal-to-monoclinic phase transformation and a precipitation of $YVO_4$ phase at the grain boundary. The results of this test suggest that the corrosion process of PSZ ceramics against $V_2O_5$ is a solution-reprecipitation process through a liquid phase.

8263 **(PB—88-253455/XAB) Development of reformer for fuel-cell system.** Watanabe, T.; Koga, M.; Morishima, S.; Toyoda, K.; Watanabe, K. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01.

Text in Japanese; Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 28, No. 3, 133-138(May 1988).

Since a fuel-cell system must respond to frequent cycling and rapid load change, a reformer generating fuel for a fuel cell should be compact and IHI is now developing the plate-type reformer for a molten carbonate fuel cell (MCFC) system. This type of reformer is superior in compactness compared to a tublar-type reformer developed for a phosphoric acid fuel cell (PACF) system. In addition, a reformer for the MCFC system must burn low-calorie off-gas from a fuel cell. The plate-type reformer ignites off-gas by using combustion catalyst and controls combustion temperature in original combustion methods. Low combustion temperature is of great advantage to structural design of the plate-type reformer and temperature-proof of combustion catalyst. The paper reports that the authors could verify the concept of the plate type reformer by the test of the 0.2-kW-class plate-type reformer conducted in 1987.

8264 **(PB—88-870647/XAB) High-temperature superconducting material: bismuth strontium calcium copper oxide. February 1988-October 1988 (Citations from the International Aerospace Abstracts data base). Report for February 1988-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 27p. NTIS PC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning the development, fabrication, and analysis of a new high temperature superconducting material based on bismuth-strontium-calcium-copper-oxides (Bi-Sr-Ca-Cu-O). Topics include the physical properties, structural and compositional analysis, magnetic field and pressure effects, and nobel metal dopings of BI-Sr-Ca-Cu-O based systems. The highest transition temperature recorded to date for this material was

120°K. Fabrication methods and properties of BI-Sr-Ca-Cu-O films and ceramics are also considered. (Contains 54 citations fully indexed and including a title list.)

8265 **(PB—89-850275/XAB) High-temperature superconducting films: yttrium barium copper oxides. January 1972-October 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1972-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 56p. NTIS PC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning the development, fabrication, characterization, and patterning of high-temperature superconducting films based on yttrium barium copper oxides (Y-Ba-Cu-O). Fabrication methods include magnetron sputtering, laser beam evaporation, sol-gel process, ion beam deposition, spin/on pyrolysis, ion implantation, and chemical vapor deposition. Structural, electrical, morphological, and optical properties of Y-Ba-Cu-O films grown on various substrates such as $SrTiO_3$, ceramics, silicon, and saphire are discussed. Effects of substrates, ion irradiation, fabrication conditions, and additives on the formation and properties of Y-Ba-Cu-O films are considered. The transition temperature of this high-temperature superconducting film is between 80 and 100°K. (Contains 110 citations fully indexed and including a title list.)

8266 **(PB—89-850804/XAB) High-temperature superconducting properties: yttrium barium copper oxides. April 1987-November 1988 (Citations from the International Aerospace Abstracts data base). Report for April 1987-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 126p. NTIS PC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning experimental and theoretical studies of high temperature superconducting properties of yttrium barium copper oxides (Y-Ba-Cu-O). Physical properties of superconducting materials and devices are discussed, including electrical, magnetic, structural, electronic, thermal, transport, optical, and elastic properties. Topics include Y-Ba-Cu-O ceramics, critical current density, critical current anisotropy, crystal structures, crystal growth, effects of dopants, crystal defects, structural phase transformation, oxygen stoichiometry, thermal degradation, and stability of Y-Ba-Cu-O materials in various environments. The most reported transition temperature (Tc) for Y-Ba-Cu-O is 90°K. The highest reported Tc was 159°K; while structural instabilities were observed up to 200°K. Citations concerning superconducting Y-Ba-Cu-O films are excluded and examined in a separate bibliography. (Contains 280 citations fully indexed and including a title list.)

8267 **(PNL-SA—15087) Gamma-ray attenuation analysis of packing structure evolution during powder consolidation.** Schilling, C.H.; Aksay, I.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 10p. (CONF-8711115—6). NTIS, PC A02/MF A01 - OSTI. Order Number TI88007840/JAW.

From 1. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

Gamma-ray attenuation measurements enable nondestructive analysis of powder packing density heterogeneities which develop during consolidation of ceramic compacts. In situ measurements of gamma-ray attenuation were performed during sedimentation of aqueous alumina suspensions to evaluate the role of suspension pH on particle rearrangement processes in cast layers. These data are used to support consolidation kinetic models describing processes of agglomerate restructuring and cast layer compaction. Porosity defects in sintered casts are correlated with pH-dependent processes of pore closure detected during sedimentation. 23 refs., 3 figs.

8268 **(PNL-SA—16173) Raman studies of chemical bonding and localized interactions.** Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 20p. (CONF-8810195—4). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004108/JAW.

From 41. Pacific coast regional meet of American Ceramic Society; San Francisco, CA, USA (24 Oct 1988).

The availability of high intensity laser systems, intensified gated array detectors, and micro-optical imaging devices has led to a resurgence of laser-based molecular spectroscopic techniques for rapid non-destructive analysis of materials. The utility of Raman spectroscopy as an in situ probe of chemical bonding in bulk materials, dielectric films, and at interfaces will be emphasized in this review. Recent work in this laboratory concerning the response of BN and titania to extreme conditions of pressure and temperature based upon changes in the vibrational Raman spectrum will be discussed. 20 refs., 9 figs.

8269 **(UCRL—99818) Radiation effects in simple metallic and enhanced multi-layer coatings employing a heat-sharing concept.** Rathkopf, J.A.; White, R.H. (Lawrence Livermore National Lab., CA (USA)). 20 Oct 1988. Contract W-7405-ENG-48. 12p. (CONF-8810246—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004023/JAW.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (26 Oct 1988).

The goal of the Survivability of Coatings program is to develop optical coatings that resist x-ray exposure damage. Analyses of mirrors consisting of a quarter-wave dielectric stack (optional), a metal reflecting layer, a beryllium heat sink, and a fused silica substrate were done using LXRT, Livermore's version of the XRT (X-Ray Transport) computer code. We use these to illustrate some design principles for hardening such mirrors against x-ray damage. Our analyses show that the addition of the beryllium significantly hardens the system against x-rays. Further hardening can be achieved by appropriate design of the dielectric stack. The mechanisms for this increased hardness are apparent from time-dependent temperature and enthalpy plots. 3 refs.

8270 **(UCRL—99856) Thermal stability and phase studies of LiH + $BeH_2$ system.** Cantrell, J.S.; Beiter, T.A.; Souers, P.C.; Barry, P. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-880969—6). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002929/JAW.

From Metal hydrogen systems fundamentals and applications conference; Stuttgart, F.R. Germany (4 Sep 1988).

Phase studies [powder x-ray diffraction (XRD)] were made of isothermally annealed material using a wide angle rotating anode diffractometer. The primary compositions studied were 1:1 and 2:1 of LiH:$BeH_2$ where the 1:1 gave $LiBeH_3$ and the 2:1 gave $Li_2BeH_4$. The thermal stability studies were made up to 425{degree}C by annealing in carefully controlled atmosphere reactors. These samples are stable long enough to obtain data without evidence of reaction. 14 refs., 2 tabs.

8271 **C-axis oriented $YBa_2Cu_3O$/sub 7-//sub x/ superconducting films by metalorganic chemical vapor deposition.** Zhang, K.; Kwak, B.S.; Boyd, E.P.; Wright, A.C.; Erbil, A. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Applied Physics Letters;* **54**: No. 4, 380-382(23 Jan 1989).

Highly textured single phase superconducting $YBa_2Cu_3O$/sub 7-//sub x/ films have been successfully grown on the yttria-stabilized zirconia (100) substrates by using the metalorganic chemical vapor deposition technique. The as-deposited films grown at 650 °C were homogeneous mixtures of the related metal oxides and carbonates. Subsequent thermal annealing under oxygen flow yielded single phase superconducting films whose thickness corresponded to the deposition rates of approximately 10 μm/h. After the post-annealing the films deposited on the yttria-stabilized zirconia substrates exhibited a highly textured x-ray pattern with c axis perpendicular to the substrate surface. These films show an onset superconducting transition temperature of 93 K with the resistance becoming zero at 84 K.

8272 **Observation of twin boundary layers in pure and alloyed $YBa_2Cu_3O$/sub 7-//sub δ/.** Zhu, Y.; Suenaga, M.; Xu, Y.; Sabatini, R.L.; Moodenbaugh, A.R. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **54**: No. 4, 374-376(23 Jan 1989).

Using an electron diffraction technique, the thicknesses of the (nonorthorhombic) twin boundary layers were measured for

pure and alloyed $YBa_2$(Cu/sub 1-//sub x/M/sub x/)$_3$O/sub 7-//sub δ/. Boundary thickness varied from ~0.7 nm for M = Ni, x = 0.02, and δ≅0 to ~2.6 nm for M = Al, x = 0.02, and δ≅0, while it was ~1.0 nm for a pure $YBa_2Cu_3O_7$. High-resolution transmission electron imaging of similar specimens supports the existence of such twin boundary layers.

**8273 New scaling relation for sputtered NbN films.** Capone D.W. II; Gray, K.E.; Kampwirth, R.T. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **65**: No. 1, 258-261(1 Jan 1989).

A scaling relationship has been discovered between the sputtering rate and the partial pressure of argon P/sub Ar/, which leaves the superconducting properties of NbN films invariant. As P/sub Ar/ increases for a given sputtering rate, there is a linear reduction of T/sub c/ together with a rapid increase, followed eventually by saturation, in H/sub c/$_2$ at 4.2 K. These produce a maximum in J/sub c/ (measured at 19 T and 4.2 K) at a particular value of P/sub Ar/. Films exhibiting nearly the same set of superconducting properties and microstructures can be made at a higher fixed sputtering rate if the values of P/sub Ar/ are multiplied by a constant scale factor. This scaling relation is found to hold for two separate sputtering systems, one of which uses a standard diffusion pump while the other uses an oilless turbo pump. Additional comparisons with the results of others reinforces the conclusion that the scaling relationship is universal and thus may provide some insight into those factors in the sputtering process which are important for determining the superconducting properties and microstructure of sputtered NbN films.

**8274 Electrohydrodynamic ion emission from molten lithium nitrate.** Panitz, J.A.; Pregenzer, A.L.; Gerber, R.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 7: No. 1, 64-68(Jan 1989).

Positive ions have been generated at the surface of molten lithium nitrate by applying a high electrostatic field to a thin layer of the molten salt on the apex of a field emitter tip. The ion emission process is characteristic of electrohydrodynamic ion formation, usually observed when a high electric field is applied to the surface of a liquid metal or alloy. With molten lithium nitrate, a single emission site appears at threshold. The divergence of the ion beam is several degrees. At higher field strengths multiple emission sites are observed. An ion species at m/e = 76 amu dominates the mass spectrum at all field strengths. This species is identified as a cluster ion $(LiNO_3)Li^+$. At low source temperatures, $(LiNO_3)_2 Li^+$ is also observed. Despite the low ionization potential of lithium (5.4 eV), $Li^+$ accounts for <8% of the total ion current generated by the source under all operating conditions. Multiply charged lithium is not detected in the mass spectra, suggesting the electric field at the Taylor cone apex is not sufficient to field-ionize singly charged species by a postionization process.

**8275 Real-time monitoring of laser ablation deposition of superconductors by fluorescence and secondary-ion spectra.** Chen, C.H.; McCann, M.P.; Phillips, R.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6378). *Applied Physics Letters;* **53**: No. 26, 2701-2703(26 Dec 1988).

Fluorescence spectra and secondary-ion spectra for laser ablation of high-temperature metal-oxide superconductors are reported. These processes can be used to monitor a thin-film deposition process. The fluorescence spectra are more suitable for Y, Ba, and Ca ions. However, ion spectra can be used to monitor and identify Tl and Ca ions easier than by fluorescence spectra.

**8276 Superconducting phase of $La_2CuO$/sub 4-//sub y/: Superconducting composition resulting from phase separation.** Jorgensen, J.D.; Dabrowski, B.; Pei, S.; Hinks, D.G.; Soderholm, L.; Morosin, B.; Schirber, J.E.; Venturini, E.L.; Ginley, D.S. (Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11337-11345(1 Dec 1988).

Superconducting samples of $La_2CuO$/sub 4-//sub y/ are shown by neutron powder diffraction to consist of two nearly identical orthorhombic phases. The primary phase has a stoichiometry near $La_2CuO_4$. The second phase is an oxygen-rich phase that is superconducting. The abundance of the second phase increases with the oxygen pressure at which the samples are annealed. Neutron-diffraction measurements as a function of temperature show that the phase separation occurs reversibly near 320 K.

**8277 Elastic response of polycrystalline and single-crystal $YBa_2Cu_3O_7$.** Hoen, S.; Bourne, L.C.; Kim, C.M.; Zettl, A. (Department of Physics, University of California at Berkeley, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11949-11951(1 Dec 1988).

The elastic response (Young's modulus and internal friction) of the high-T/sub c/ superconductor $YBa_2Cu_3O_7$ has been measured in single-crystal and polycrystalline specimens. For the first time we resolve the small expected lattice softening associated with the superconducting phase transition. The anomalous lattice stiffening below T/sub c/ in polycrystalline samples is present also in single crystals.

**8278 Cu adatom interactions with single- and polycrystalline $Bi_2Ca$/sub 1+//sub x/Sr/sub 2-//sub x/$Cu_2O$/sub 8+//sub y/ and $YBa_2Cu_3O$/sub 7-//sub x/.** Hill, D.M.; Meyer H.M. III; Weaver, J.H.; Gallo, C.F.; Goretta, K.C. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11331-11336(1 Dec 1988).

The electronic structure and surface interactions vapor-deposited Cu on single-crystal and polycrystalline $Bi_2Ca$/sub 1+//sub x//sub Sr>2-//sub x//sub Cu>2/O/sub 8+//sub y/ were studied using x-ray photoelectron spectroscopy. The results are compared to the Cu/$YBa_2Cu_3O$/sub 7-//sub x/ interface. Changes in the Cu 2p satellite emission indicate that the Cu adatoms do not disrupt $Bi_2Ca$/sub 1+//sub x/Sr/sub 2-//sub x/$Cu_2O$/sub 8+//sub y/ as extensively as $YBa_2Cu_3O$/sub 7-//sub x/. However, deposition of Cu induces changes in the Bi environment in the superconductor, and surface segregation of Bi metal was observed at high coverages. Core-level attenuation results suggests minimal outdiffusion of oxygen, in contrast with what is observed for Cu/$YBa_2Cu_3O$/sub 7-//sub x/.

**8279 Free-energy surfaces for superconducting $Y_1Ba_2Cu_3O_7$.** Athreya, K.S.; Hyun, O.B.; Ostenson, J.E.; Clem, J.R.; Finnemore, D.K. (Ames Laboratory, U. S. Department of Energy, and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11846-11849(1 Dec 1988).

Magnetization studies were undertaken to determine the change in free energy of the superconducting state of $Y_1Ba_2Cu_3O_7$ with changes in magnetic field and temperature. Close to the transition temperature T/sub c/ magnetic flux moves easily and reversibly in these materials so that magnetization is a thermodynamically reversible variable. Hence, the free-energy surfaces can be measured and quantities such as entropy and specific heat can be derived. Magnetization is found to be linear in (T/sub c/-T)$^2$ near T/sub c/. The free-energy surface shows substantial changes with magnetic field all the way up to 92 K, well outside the usual H/sub c/$_2$K vs T plots derived from resistivity or ac susceptibility data.

**8280 Specific-heat measurements on superconducting Bi-Ca-Sr-Cu and Tl-Ca-Ba-Cu oxides: Absence of a linear term in the specific heat of Bi-Ca-Sr-Cu oxides.** Fisher, R.A.; Kim, S.; Lacy, S.E.; Phillips, N.E.; Morris, D.E.; Markelz, A.G.; Wei, J.Y.T.; Ginley, D.S. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11942-11945(1 Dec 1988).

Specific-heat data, extending from 0.4 to 120 K in both a zero field and at 7 T, are reported for five samples of Bi-Ca-Sr-Cu

oxide and one of Tl-Ca-Ba-Cu oxide. The occurrence of bulk superconductivity in all six samples is shown by Meissner-effect measurements, and confirmed for the Tl sample and two Bi samples by the specific-heat data. In a zero field, the Tl sample shows a contribution to the specific heat that is linear in temperature and comparable to those reported for $YBa_2Cu_3O_7$. For all samples of the Bi compound the linear term is zero within the experimental uncertainty, and is at least an order of magnitude smaller.

**8281 Orientation of the O 2p holes in $Bi_2Sr_2Ca_1Cu_2O_8$.** Himpsel, F.J.; Chandrashekhar, G.V.; McLean, A.B.; Shafer, M.W. (IBM Research Division, T. J. Watson Research Center, Yorktown Heights, New York 10598). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11946-11948(1 Dec 1988).

Unoccupied O 2p states are observed in $Bi_2Sr_2Ca_1Cu_2O_8$ near the Fermi level. They show up as a spike in the O 1s absorption edge at threshold ($h\nu = 528.2$ eV). The orientation of these O 2p states is determined via optical selection rules from the polarization dependence of the absorption using single crystals. The O 2p holes are found to have at least 95% p/sub x//sub ,//sub y/ character with x,y in the superconducting a-b plane.

**8282 Reversible magnetization of high-T/sub c/ materials in intermediate fields.** Kogan, V.G.; Fang, M.M.; Mitra, S. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11958-11961(1 Dec 1988).

In high-T/sub c/ superconductors there exists a broad field domain, in which the reversible magnetization M is linear in the logarithm of the applied field H/sub a/. The dependence M(lnH/sub a/) is obtained taking the strong uniaxial anisotropy into account. It is shown, that for an arbitrary orientation of the single crystal with respect to H/sub a/ the magnetization vector has a component normal to the applied field comparable to the usually measured component parallel to H/sub a/. A procedure is suggested for extracting the value of the penetration depth from the linear part of M(lnH/sub a/). Being applied to the data available for $Y_1Ba_2Cu_3O_7$, the method yields λproportional(T/sub c/-T)/sup -1/2/ near T/sub c/ up to temperatures (T/sub c/-T)/T/sub c/∼10/sup -3/. This puts an upper bound upon the value of the temperature domain, in which the underlying mean-field theory is valid.

**8283 Photoemission from single crystals of $EuBa_2Cu_3O$/sub 7-//sub x/ cleaved below 20 K: Temperature-dependent oxygen loss.** List, R.S.; Arko, A.J.; Fisk, Z.; Cheong, S.W.; Conradson, S.D.; Thompson, J.D.; Pierce, C.B.; Peterson, D.E.; Bartlett, R.J.; Shinn, N.D.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11966-11969(1 Dec 1988).

The first low-temperature photoemission spectra from well-oxygenated and characterized, cleaved single crystals of the 1:2:3-type superconductors, specifically $EuBa_2Cu_3O$/sub 7-//sub x/, are presented. In contrast with polycrystalline or higher-temperature single-crystalline studies, a distinct and very stable density of states is found at the Fermi edge below 20 K. As the crystal is warmed even to 80 K the emission is rapidly lost from both the upper and lower portions of the Cu-O hybrids. At room temperature there is a loss of intensity at the Fermi edge with an accompanying change in the Ba 4d core-level line shape and the presence of a charging effect indicative of an insulating surface. These results imply that upon warming from 20 K there is very rapid oxygen loss from the cleaved surface with a resulting loss of superconducting behavior. This suggests that future photoemission experiments, especially those investigating detailed band structure, should be performed at low temperatures.

**8284 Magnetic ordering in $GdBa_2Cu_3O$/sub 6.14/.** Mook, H.A.; Paul, D.M.; Sales, B.C.; Boatner, L.A.; Cussen, L. (Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37830). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 12008-12010(1 Dec 1988).

Neutron scattering has been used to determine the magnetic order of the Gd in the oxygen-deficient compound $GdBa_2Cu_3O$/sub 6.14/. The ordering is found to be identical to that found earlier for the superconducting composition by Paul et al. This differs from a result by Chattopadhyay et al., who found a variation in the magnetic structure of the oxygen-deficient compound.

**8285 (AD-A—198717/1/XAB) Brittleness and toughening of ceramics.** Jingkun, G. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 21 Jul 1988. Trans. of Guisvanyan Xuebao (China), Vol. 15, No. 5, 385-393(Oct 1987). (FTD-ID(RS)T—0419-88). 16p. NTIS, PC A03/MF A01.

Improving the brittleness of ceramic materials has long been a problem of concern to ceramists. Fiber-reinforcing and zirconia phase-transformation toughening have been proven to be effective approaches in practice for improving the brittleness as well as the strength of ceramics. This paper briefly discusses some problems in the study of the above two approaches. The importance of chemical compatibility between fiber and matrix is pointed out in the study of fiber-reinforced-ceramic composite materials; the matches of the two in thermal expansion and elastic modulus can not be neglected either, and the moderate bonding of the two boundary surfaces is considered appropriate.

**8286 Mass transport and chemical demixing of Y-Ba-Cu-O compounds during sintering in temperature gradients.** Rahaman, M.N.; DeJonghe, L.C.; Chu, M.Y. (Ceramic Engineering Dept., Univ. of Missouri, Rolla, MO (US)). *Journal of the American Ceramic Society;* **71**: No. 5, C237-C240(May 1988).

A thin cylindrical powder compact (3-mm diameter by 20-mm) with a nominal composition of YBa/sub 2/Cu/sub 3/O/sub x/ was sintered in a static temperature gradient of 25°C/mm in air for 12 h. The temperature at the hot end of the sample was maintained at 940°+-5°C. Considerable mass transport and chemical demixing occurred along the length of the sample. The results are consistent with the formation of a liquid phase at the hot end of the sample, transport of the liquid down the temperature gradient, and the formation of different eutectic compositions along the length of the sample. The implications for processing high-T/sub c/ superconductors in the system Y-Ba-Cu-O are discussed.

**8287 Segregation of magnesium and calcium to the (101-bar0) prismatic surface of magnesium-implanted sapphire.** Mukhopadhyay, S.M.; Jardine, A.P.; Blakely, J.M.; Baik, S. (Dept. of Materials Science and Engineering, Cornell Univ., Ithaca, NY (US)). *Journal of the American Ceramic Society;* **71**: No. 5, 358-362(May 1988).

Auger electron spectroscopy was used to study the segregation of magnesium and calcium to the prismatic plane of sapphire doped with Mg by ion implantation. Segregation behavior depended strongly upon the annealing atmosphere. Air annealing showed Mg segregation to the free surface whereas vacuum annealing resulted in no observable Mg segregation above the detectability limit of our instrument. This is attributed to excessive vaporization of MgO at low oxygen pressures. In the absence of Mg on the surface, strong Ca segregation was observed although the bulk concentration of Ca was below 40 ppm, the total impurity level. The effective heat of segregation of Mg in the air was found to be about -1.4eV in the temperature range 1300° to 1550°C. The Ca coverage on the surface did not follow a Langmuir plot, probably because of a Ca-Ca interaction at the larger surface concentrations. The implication of these results to the understanding of transport-related properties of impurity-doped alumina is discussed.

**8288 Evaluation of bridging stress from R-curve behavior for nontransforming ceramics.** Hsueh, C.H.; Becher, P.F. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *Journal of the American Ceramic Society;* **71**: No. 5, C234-C237(May 1988).

Bridging stresses at the crack interface behind the crack tip are calculated for nontransforming ceramics which show increasing toughness with crack extension (R-curve behavior). With this approach, bridging stresses can be related analytically to the experimental R curve. Sample calculations for SiC-whisker-reinforced Al/sub 2/0/sub 3/ with a bridging-zone length of >0.5 mm, are

shown in the present study. The results indicate that the bridging stress has a maximum value within a short distance (<0.01mm) behind the crack tip and then decreases to 0 or levels off to a finite value at the end of the bridging zone depending upon the nature of the R-curve behavior.

8289 **Bulk superconductivity at 60 K in oxygen-deficient $Ba_2YCu_3O/sub\ 7-\delta/$ and oxygen isotope effect in La/sub 1.85/Sr/sub 0.15/$CuO_4$.** Batlogg, B.; Cava, R.J.; Chen, C.H.; Kourouklis, G.; Weber, W.; Jayaraman, A.; White, A.E.; Short, K.T.; Rietman, E.A.; Rupp, L.W.; Werder, D. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 653-657 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Oxygen deficient polycrystalline samples of $Ba_2YCu_3O/sub\ 7-\delta/$ have been prepared by a Zr-gettered annealing technique. A distinct bulk superconducting phase with a T/sub c/ of 60 K is found for $0.3 < \delta < 0.4$, which has partial ordering of the O vacancies in the Cu-O chains. This ordering is seen in electron diffraction studies and also in both the value and the temperature dependence of the electrical resistivity. Isotope effect studies on La/sub 1.85/Sr/sub 0.15/$CuO_4$ have been performed by partially substituting $^{18}O$ for $^{16}O$. Raman spectroscopy confirms the expected frequency shift of the 428 $cm^{-1}$ phonon line and T/sub c/ is found to decrease. The isotope effect exponent $\alpha$ is 0.16 +/- 0.02, in contrast to $Ba_2YCu_3O_7$ where $\alpha$ is 0 +/- 0.02.

8290 **Bulk modulus anomalies at the superconducting transitions of single-phase $YBa_2Cu_3O_7$ and La/sub 1.85/Sr/sub .15/$CuO_4$.** Bishop, D.J.; Gammel, P.L.; Ramirez, A.P.; Batlogg, B.; Cava, R.J.; Millis, A.J. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 659-662 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The changes in sound velocity have been measured in the two high-T/sub c/ superconductors $(La,Sr)_2CuO_4$ and $YBa_2Cu_3O_7$ from room temperature through their superconducting transitions. Both systems exhibit anomalous behavior at T/sub c/. In a conventional superconductor at T/sub c/ there is a small drop in the sound velocity typically of the order of a few ppm and the sound velocity at T = 0 stays below its value at T/sub c/. In La/sub 1.85/Sr/sub .15/$CuO_4$ there is a large drop (~ 150 ppm) at T/sub c/ and then a large hardening below T/sub c/ of ~ 1000 ppm. In $YBa_2Cu_3O_7$ there is no drop at T/sub c/ but there is a large hardening below T/sub c/ of ~ 1000 ppm. In both cases the hardening seems to scale with the superconducting gap squared. This behavior is shown in both La/sub 1.85/Sr/sub .15/$CuO_4$ and $YBa_2Cu_3O_7$.

8291 **Absence of resistivity saturation and its implications for the high T/sub c/ superconductors.** Gurvitch, M.; Fiory, A.T. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 663-677 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Temperature-dependent resistivity rho(T) was measured from T/sub c/ to 1100K in ceramic samples of La/sub 1.825/Sr/sub 0.175/$CuO_4$ (LSCO) and $YBa_2Cu_3O_7$ (YBCO). Measurements above 300 K were performed in a flow of $O_2$. In LSCO rho(T) is linear to 1100K; in YBCO rho(T) is linear to 600 K, increases faster than linear at T > 600 K, owing to the loss of oxygen, and shows a break in slope at the structural phase transition near 950 K. It is argued that the observed absence of saturation in the linear parts of the data implies weak electron-phonon coupling in both superconductors, and, coupled with absolute values of the resistivity, places constraints on band structure parameters. Their results take anisotropy into account explicitly and are combined with recent $\mu$SR measurements of the penetration depth to obtain experimental estimates of the plasma energy.

8292 **EPR, magnetization, and resistivity studies in doped (4f, 3d ions) and undoped R (or Y) $Ba_2Cu_3O/sub\ 9-x/$ high T/sub c/ superconductors.** Oseroff, S.B.; Vier, D.C.; Smyth, J.F.; Salling, C.T.; Schultz, S.; Dalichaouch, Y.; Lee, B.W.; Maple, M.B.; Fisk, Z.; Thompson, J.D.; Smith, J.L. (San Diego State Univ., CA (USA)). pp 679-687 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The high temperature superconducting phase has been identified as $RBa_2Cu_3O/sub\ 9-x/$ with an orthorhombically distorted, oxygen deficient, perovskite-like structure. It has been suggested that the high temperature superconductivity is associated with a two-dimensional structure in which two $CuO_2$ layers sandwich one $CuO_3$ chain, with two $Ba^{2+}$ cations per unit cell. Because the Cu ions seem to be the essential component of the conduction path in these oxides, the effects of doping were studied with several percent of 3d ions, particularly those which also form local moments. Measurements were made of the suppression of T/sub c/, the changes in magnetic susceptibility, and the nature of the Electron Paramagnetic Resonance (EPR) signals in compounds of nominal composition $EuBa_2$ (Cu/sub 1-6/M/sub y/)$_3O/sub\ 9-x/$ where M = Cr, Mn, Fe, Co, Ni, or Zn and $y \leqq 0.15$. The EPR signals were examined in the pure oxide compounds $RBa_2Cu_3O/sub\ 9-x/$, with R = Y, Pr, Nd, Eu, Gd, Ho, Er, or Yb; and in the compounds (R/sub 1-x/R'/sub z/$Ba_2Cu_3O/sub\ 9-x/$, with R = Eu or Y, R' = Gd or Er, and $z < 0.05$. EPR will be a fruitful technique to apply to the superconducting oxides since EPR enables the study of the static and dynamic interactions between added local moments and (hopefully) the conduction electron system, as has been shown for more well known metal systems and Type II superconductors.

8293 **Upper critical field measurements for $RBa_2Cu_3O_7$ (R = Y,Eu/sub .9/Y/sub .1/,Sm).** Ramirez, A.P.; Batlogg, B.; Cava, R.J.; Schneemeyer, L.; van Dover, R.B.; Rietman, E.A.; Waszczak, J.V. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 689-691 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The upper critical fields have been measured for superconducting $RBa_2Cu_3O_7$ (R = Y,Eu/sub .9/Y/sub .1/,Sm) up to 27 Tesla, using the midpoint, T/sub m/, of the resistance transition. At the highest fields, critical field slopes of absolute value of dH/sub c2//dT/sub m/ = 2.5, 2.1, and 3.3 Tesla/K for R = Y, Eu/sub .9/Y/sub .1/ and Sm, respectively, were found indicating insensitivity of pairing to local moment magnetism in these compounds. The normal state magnetoresistance is extremely small ($< 10^{-2}$).

8294 **Cu-O superconductors: through a lens, but darkly.** Orenstein, J.; Thomas, G.A.; Rapkine, D.H.; Bethea, C.G.; Levine, B.F.; Cava, R.J.; Cooper, A.S.; Johnson, D.W. Jr.; Remeika, J.P.; Rietman, E.A. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 693-698 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Measurements of reflectivity R, for single crystal samples of $La_2CuO_4$ (c-La) and pressed pellets of ceramic La/sub 2-x/Sr/sub x/$CuO_4$ (LaSr) for x = 0, 0.04, 0.075, 0.175, 0.225 are reported. A plot of R vs log nu for c-La is shown. The samples were cube-like objects approximately 2 mm on a side, which were polished as previously described.

8295 **Single crystal superconducting $Y_1Ba_2Cu_3O/sub\ 7-x/$ oxide films by molecular beam epitaxy.** Kwo, J.; Hong, M.; Fleming, R.M.; Hsieh, T.C.; Liou, S.H.; Davidson, B.A. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 699-703 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Recent breakthrough of superconductivity over 90K in the Cu oxide based perovskite-type materials is of immense importance in both science and technology. The superconducting oxide crystals prepared in thin film form are vital for fundamental physical studies as well as for device applications. The structural and superconducting properties of single crystal $Y_1Ba_2Cu_3O$/sub 7-x/ films prepared by molecular beam epitaxy (MBE) developed for thin film semiconductor technology are reported. The films are epitaxial crystals grown on $SrTiO_3$ (100) face with an orientation of a axis perpendicular to the film plane. Sharp resistive superconducting transitions with T/sub c/ (R = 0) above 77 K have been reproducibly achieved. The critical current densities are $10^3$ A/cm$^2$ at 77 K, 5 x $10^4$ A/cm$^2$ at 70 K, and $\sim 10^6$ A/cm$^2$ at 4.2 K.

8296 **Chemical doping and physical properties of the new high temperature superconducting perovskites.** Tarascon, J.M.; Greene, L.H.; Bagley, B.G.; McKinnon, W.R.; Barboux, P.; Hull, G.W. (Bell Communications Research, Red Bank, NJ (USA)). pp 705-724 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The effects of chemical doping on the structural, magnetic, transport and superconducting properties of the new high T/sub c/ superconducting oxides are reviewed. The substitution of Sr or rare earths for La in $La_2CuO$/sub 4-6/ and the replacement for Y by rare earths and for Ba by Sr in the $YBa_2Cu_3O$/sub 7-y/ system have been investigated, as well as the substitution of Ni for Cu in both systems. In contrast to the rare earth substitutions, a Ni substitution dramatically affects T/sub c/. The importance of the oxygen content (y) in these oxides, which strongly depend on their processing conditions (heat treating time, temperature and ambient), is emphasized and a detailed study of changes in the physical properties as a function of y is reported. The superconducting properties of these perovskites can be destroyed by decreasing their oxygen content. However, full superconductivity can be recovered by reannealing the sample under oxygen or by a low temperature (80°C) plasma oxidation. The latter method may be very useful for the technological application of these materials.

8297 **Properties of oriented oxide superconductor thin films prepared by pulsed laser evaporation from high T/sub c/ bulk material.** Dijkkamp, D.; Wu, X.D.; Ogale, S.B.; Inam, A.; Chase, E.W.; Miceli, P.; Tarascon, J.M.; Venkatesan, T. (Bell Communications Research, Red Bank, NJ (USA)). pp 725-731 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The preparation is reported of thin films of Y-Ba-Cu-O superconductors using pulsed excimer laser evaporation of bulk material. Rutherford backscattering spectrometry showed the composition of these films to be close to that of the bulk material. Growth rates were typically 1 nm per laser shot. This new deposition method is relatively simple, very versatile, and does not require the use of ultrahigh vacuum techniques. After an annealing treatment in oxygen the films exhibited superconductivity with zero resistance in the range 55 K - 85 K, depending on the annealing conditions and the type of substrate. In particular, films prepared on $SrTiO_3$ <100> showed transition widths as narrow as 2 K, and a considerable amount of orientation, as observed by X-ray diffraction and ion channeling techniques. There is evidence for strong interface reaction with in-diffusion of Ba and Cu and out-diffusion of Ti and Sr, resulting in a thickness dependence of the superconducting properties of the films.

8298 **Oxygen isotope effect in the high temperature superconductors $YBa_2Cu_3O$/sub 7-δ/ and La/sub 1.85/Sr/sub 0.15/$CuO_4$, with $^{18}O$ substituted by diffusion.** Cohen, M.L.; Morris, D.E.; Stacy, A.; Zettl, A. (Univ. of California, Berkeley (USA)). pp 733-738 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC03-76SF00098.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A non-zero oxygen isotope shift has been observed in the superconducting oxide La/sub 1.85/Sr/sub 0.15/$CuO_4$, in sharp contrast to observations of no oxygen isotope shift in $YBa_2Cu_3O$/sub 7-δ/. Substitution of $^{18}O$ for $^{16}O$ in La/sub 1.85/Sr/sub 0.15/$CuO_4$ results in a depression of the superconducting transition temperature T/sub c/. The substitution was carried out in a similar manners as in $YBa_2Cu_3O$/sub 7-δ/ but was more difficult. Magnetic (Meissner effect) and resistive measurements indicated that T/sub c/ is depressed by 0.3 - 1.0K in various samples when the isotope $^{18}O$ is substituted for 65% to 78% of the $^{16}O$ in the sample. The observed shifts in T/sub c/ were extrapolated to 100% $^{18}O$. With T/sub c/ $\approx$ M/sup -α/, where M is the oxygen mass, they find $0.10 < \alpha < 0.35$. This non-zero isotope shift indicates that in La/sub 1.85/Sr/sub 0.15/$CuO_4$, phonons may play an important role in the superconductivity mechanism. The consequences of this result for phonon mediated electron pairing are examined within the framework of BCS theory.

8299 **Magnetic field dependence of the specific heat of some high-T/sub c/ superconductors.** Phillips, N.E.; Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Ham, W.K.; Stacy, A.M. (Univ. of California, Berkeley (USA)). pp 739-743 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC03-76SF00098.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Measurements of specific heat, C, were made on samples of $La_2CuO$/sub 4-y/ (Lal), La/sub 1.85/M/sub 0.15/CuO/sub 4-y/ (Cal, Srl, Sr2, Bal and Ba2) and $YBa_2Cu_3O$/sub 9-y/ (Y1). Meissner effect measurements were made in 12.5G. The high-temperature onset of a change in magnetic susceptibility, chi, was taken as T/sub c/, and the transition width, ΔT/sub c/, as the temperature interval of the 10-90% change in chi. Calculation of the fractional Meissner effect, -4πchi/sub V/, was based on the total sample volume, with chi/sub V/ corrected for demagnetizing effects.

8300 **Summary of some work on high temperature superconductors at Brookhaven National Laboratory.** Strongin, M. (Brookhaven National Lab., Upton, NY (USA)). pp 745 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A summary is presented of recent high T/sub c/ superconductivity work by the Brookhaven staff. Significant work done by outside users on the major facilities is not discussed here. Theoretical work on mechanisms of superconductivity, is discussed separately elsewhere in this proceedings. The experimental work can be divided into two major categories; scattering and spectroscopy experiments at the Brookhaven facilities, and measurements of the macroscopic electrical and magnetic properties of the superconductors, as well as an additional contribution on sample preparation. An example of the complimentary nature of these techniques is shown for the case of penetration depth measurements, where the value of λ obtained using mu mesons as a microscopic probe of the internal fields is different than that obtained inductively. This difference leads to some insight into the inter-granular coupling.

8301 **Neutron powder diffraction study of $Ba_2YC_3O_7$.** Cox, D.E.; Moodenbaugh, A.R.; Hurst, J.J.; Jones, R.H. (Brookhaven National Lab., Upton, NY (USA)). pp 746-747 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The structure of an orthorhombic sample of $Ba_2YCu_3O_7$ with a superconducting transition at 89K has been determined by Rietveld profile analysis of neutron powder diffraction data. The relationship between the ideal cubic perovskite structure, the orthorhombic $Ba_2YCu_3O_7$ structure and a disordered form of the latter with tetragonal symmetry is given. The stereochemistry of the Cu-O networks is presented in detail.

8302 **Structural phase transformations and high-T/sub c/ superconductivity.** Axe, J.D.; You, H.; Hohlwein, D.; Cox, D.E.; Moss, S.C.; Forster, K.; Hor, P.; Meng, R.L.; Chu, C.W. (Brookhaven National Lab., Upton, NY (USA)). pp 748-750 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The recent discoveries of T/sub c/ $\approx$ 40K (much higher T/sub c/'s are rumored) in the $La_2CuO_4$-type systems raise questions concerning the importance of lattice instabilities to superconductivity in these systems. High resolution synchrotron x-ray powder diffraction measurements were performed on the superconductor La/sub 1.8/Ba/sub 0.2/$CuO_4$ which show unusual temperature dependent broadening of certain Bragg peaks. This pattern of peak broadening can be consistently explained as an unresolved splitting due to a spontaneous reduction of the tetragonal symmetry of the high temperature structure to a lower monoclinic (or possibly triclinic) form. In order to confirm this interpretation of the powder diffraction data, the size of the highly collimated synchrotron x-ray beam was reduced and individual $\approx$ 70 $\mu$m single crystals were isolated and studied within the powder aggregate.

8303 **Neutron scattering studies of $La_2CuO$/sub 4-$\delta$/.** Freltoft, T.; Remeika, J.P.; Moncton, D.E.; Cooper, A.S.; Fischer, J.E.; Harshman, D.; Mitsuda, S.; Shirane, G.; Sinha, S.K.; Vaknin, D.; Yang, B.X. (Brookhaven National Lab., Upton, NY (USA)). pp 751-752 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

In order to investigate in detail how the magnetic and structural properties of $La_2CuO$/sub 4-$\delta$/ are related to the oxygen deficiency $\delta$, a series of single crystals was grown and heat-treated in vacuum at different temperatures. It was found that the magnetic structure is independent of oxygen deficiency $\delta$, while the transition temperature T/sub N/ and the magnetic moment $\mu$ per Cu atom strongly depend on $\delta$. It was also found that the orthorhombic distortion, measured as the relative difference of the lattice constants a and c, c/a - 1 is not very sensitive to the oxygen concentration at low temperature. (a = c in the high temperature tetragonal phase.)

8304 **Superconducting properties and structural characterization of high Tc oxides.** Moodenbaugh, A.R.; Hurst, J.J.; Asano, T.; Sabatini, R.L.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). pp 767-769 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A desire to provide good quality oxide superconducting specimens for research in their materials laboratory and for collaborators at the Synchrotron Light Source, High Flux Beam Reactor, and Alternating Gradient Synchrotron required characterization of samples. Earlier, straightforward methods for preparation of $YBa_2Cu_3O_7$ superconductors were described. However, these methods are not completely defined, and samples prepared nominally according to the recipe may vary in superconducting properties and with respect to the presence of non superconducting minority phases (primarily observed in x-ray diffraction work). Here methods are described for preparing and characterizing these materials.

8305 **Variation of T/sub c/ with hole concentration in La/sub 2-x/Sr/sub x/CuO/sub 4-$\delta$/ superconductors and comparison with $YBa_2Cu_3O$/sub 7-$\delta$/.** Shafer, M.W.; Penney, T.; Olson, B.L. (IBM T. J. Watson Research Center, Yorktown Heights, NY (USA)). pp 771-779 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Superconductivity shown to be related to the electron deficiency (hole concentration) in the copper-oxygen layer. Resistivity and Hall data for the La-Sr-Cu-oxide system is compared with that of $YBa_2Cu_3O_7$. The results are consistent with recent non-phonon theories of oxide superconductivity based on strongly correlated electrons or dynamic peroxide formation.

8306 **Anisotropy in single-crystal $Y_1Ba_2Cu_3O$/sub 7-x/.** Worthington, T.K.; Gallagher, W.J.; Dinger, T.R.; Sandstrom, R.L. (IBM T. J. Watson Research Center, Yorktown Heights, NY (USA)). pp 781-785 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Considerable activity on high-T/sub c/ superconductivity in Cu-O based perovskites has followed the breakthrough discovery of superconductivity in this class of materials by Bednorz and Mueller. Nevertheless, the macroscopic nature of the superconductivity in these new materials and the mechanism responsible for their superconductivity are still unclear. The recent availability of single crystals of the new Cu-O based superconductors has led to the observation of considerable anisotropy in resistivity, critical current density, and upper and lower critical fields. In this paper they summarize their recent measurements of H/sub c2/, H/sub c1/, and critical current density as a function of orientation for single crystal $Y_1Ba_2Cu_3O$/sub 7-x/. This data was used to estimate the anisotropic Ginzburg-Landau parameters. It was found that the anisotropic Ginzburg-Landau theory describes the data well near T/sub c/ and that, although the superconductivity in $Y_1Ba_2Cu_3O$/sub 7-x/ is strongly anisotropic, it is three dimensional in nature. Elaborations of available theories are needed to explain lower temperature features of the data.

8307 **Present status of high T/sub c/ oxide superconductivity studies at Tohoku University.** Muto, Y.; Kobayashi, N.; Syono, Y. (Tohoku Univ., Sendai (Japan)). pp 787-799 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The present status of studies of new high T/sub c/ oxide superconductors held at Institute for Materials Research, Tohoku University, is described. On single phase orthorhombic $YBa_2Cu_3O$/sub 6.74/ and tetragonal $YBa_2Cu_3O$/sub 6.05/, results of sample preparation, thermal and X ray analyses, high resolution electron microscopy study, and neutron diffraction study are reviewed. The electrical resistivity measurements are done on $YBa_2Cu_3O$/sub 6.74/ and $ErBa_2Cu_3O$/sub z/ under magnetic fields up to 21.6 Tesla. H/sub c2/(0) of $YBa_2Cu_3O$/sub 6.74/ and $ErBa_2Cu_3O$/sub z/ are 150 and 200 Tesla, respectively. In addition, the resistance of $YBa_2Cu_3O$/sub 6.74/ begins to appear at 2 Tesla but that of $ErBa_2Cu_3O$/sub z/ does not appear till 5 Tesla.

8308 **Current carrying properties in high T/sub c/ Y-Ba-Cu-O system.** Noto, K.; Watanabe, K.; Morita, H.; Murakami, Y.; Yoshii, I.; Sato, I.; Sugawara, H.; Kobayashi, N.; Fujimori, H.; Muto, Y. (Tohoku Univ., Sendai (Japan)). pp 801-805 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The transition temperature, T/sub c/, and the critical current density, J/sub c/(B), at 4.2 K have been studied in high T/sub c/ Y-Ba-Cu oxide system. A very large anisotropy, very fast degradations at low fields, and a large hysteresis in J/sub c/(B) have been observed in this system. The cause of the large anisotropy might be the strong c-axis orientation parallel to the direction of the pressing and the low dimensionality of the crystal structure of this material. Although J/sub c/ value is very small, the decrease in J/sub c/ with increasing magnetic field from 2 to 27 T is estimated to amount to only about 20%, which shows a high potential for practical use at high fields when J/sub c/ is raised by the introduction of strong pinning centers in the Y-Ba-Cu oxide system.

8309 **Preparation, structure, and magnetic field studies of high T/sub c/ superconductors.** Osofsky, M.S.; Fuller, W.W.; Toth, L.E.; Qadri, S.B.; Lawrence, S.H.; Hein, R.A.; Gubser, D.U.; Wolf, S.A.; Pande, C.S.; Singh, A.K.; Skelton, E.F. (Naval Research Lab., Washington, DC (USA)). pp 807-815 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Preparation and characterization were conducted on high T/sub c/ single phase samples of La/sub 2-x/M/sub x/$CuO_4$ (where M=Sr, Ba, and Ca and x = 0.1, 0.2 or 0.3) and $Ba_2YCu_3O_7$. Transmission electron microscopy of the $Ba_2YCu_3O_7$ samples reveals twinning defects in the [110] direction which disappear when the sample is heated above 400°C. The dc susceptibility, magnetization, and magnetoresistance are reported. Many of the critical superconducting and normal state parameters have been extracted from the data.

8310 **Magnetic behavior of YBaCuO.** Datta, T.; Almasan, C.; Gubser, D.U.; Wolf, S.A.; Osofsky, M.; Toth, L.E. (Univ. of South Carolina, Columbia (USA)). pp 817-823 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The d.c. magnetization M(T), and susceptibility chi(T), of YBaCu-oxide superconductors, as a function of external d.c. field, temperature and experimental protocols. Specimens of simply connected and multiply connected topology such as a macroscopic ring, were examined.

8311 **Coupled structural and electrical transition in $La_2CuO_4$ near 30 K.** Skelton, E.F.; Elam, W.T.; Gubser, D.U.; Hein, R.A.; Letourneau, V.; Osofsky, M.S.; Qadri, S.B.; Toth, L.E.; Wolf, S.A. (Naval Research Lab., Washington, DC (USA)). pp 825-827 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Based on first principles calculations, Pickett et al predicted that tetragonal $La_2CuO_4$ should be superconducting. However, resistance measurements of Jorgensen et al on $La_2CuO_4$ indicated that the material is metallic down to about 100 K, below which it behaves like a doped semiconductor. Most recently Grant et al reported evidence of superconductivity below 40 K of 1 part in 6000 of $La_2CuO_4$. In consideration of the presence of both metal-like and semiconductor-like behavior in this material, Kasowski et al performed band structure calculations and group theoretical analyses. From this, they suggested that $La_2CuO_4$ may undergo a structural phase transition at lower temperatures from the orthorhombic phase to a lower symmetry phase, possibly monoclinic. The authors have found evidence of such a transition and find that it is correlated with a change in the resistance near 30 K.

8312 **Experiments on heavy electron and high T/sub c/ oxide superconductors.** Maple, M.B.; Dalichaouch, Y.; Ferreira, J.M.; Hake, R.R.; Lambert, S.E.; Lee, B.W.; Neumeier, J.J.; Torikachvili, M.S.; Yang, K.N.; Zhou, H.; Fisk, Z. (Univ. of California, San Diego, La Jolla (USA)). pp 839-853 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract FG03-86ER45230.

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Efforts to determine the type of pairing and pairing mechanisms that are associated with the superconductivity of heavy electron materials by means of H/sub c2/(T) measurements in Gd-doped (U/sub 1-x/Th/sub x/)$Be_{13}$ alloys are described. Recently, detailed studies were conducted of the physical properties of the $RBa_2Cu_3O$/sub 7-δ/ compounds where R is rare earth element (except for Pm), in addition to $YBa_2Cu_3O$/sub 7-δ/. All of the compounds exhibit superconductivity, except for R = Ce, Pr and Tb.

8313 **Flux quantum and tunnel characteristics of La/sub 2-x/Sr/sub x/$CuO_4$ (x=0.05-0.2) and $MBa_2Cu_3O_7$ (M-Lu,Y) ceramics.** Zavaritsky, N.V.; Zavararitsky, V.N.; Petrov, S.V. (Institute for Physical Problems, Moscow (USSR)). pp 871-873 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Macroscopic scale phase coherence in high T/sub c/ ceramics was observed both in magnetic field and/or current superconductivity destruction and during flux quantization tests. Temperature dependence of superconducting energy gap was obtained from point contact tunnel experiments. The maximum values of 2 $\delta_0$/kT/sub c/ obtained for La/sub 1.85/Sr/sub 0.15/$CuO_4$ and $YBa_2Cu_3O_7$ are 5 and 7.5 respectively.

8314 **Effect of disordering on the properties of high-temperature ceramic superconductors.** Voronin, V.I.; Goshchitskii, B.N.; Davydov, S.A.; Karkin, A.E.; Kozhevnikov, V.L.; Mirmelshtein, A.V.; Parkhomenko, V.D.; Cheshnitskii, S.M. (Institute of Metal Physics, Sverdlovsk (USSR)). pp 875-881 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The first data is reported on radiation effects in the new ceramic superconductors La/sub 1.83/Sr/sub 0.17/CuO/sub 4-y/ and $R_1Ba_2Cu_3O$/sub 7-y/ (R = Y, Ho, Er) irradiated by fast neutrons (E/sub n/ > 1 MeV, T/sub irr/ similarly ordered 350 K) with flux ranging from 5 x $10^{17}$ to 1 x $10^{19}$ $cm^{-2}$. $V_3Si$ has been chosen for comparison as it is the most extensively studied superconducting intermetallic compound about the physical nature and radiation effects of which there is virtually no doubt.

8315 **Anomalous behavior of the elastic characteristics of $YBa_2Cu_3O_7$ near T/sub c/.** Golovashkin, A.I.; Danilov, V.A.; Ivanenko, O.M.; Leitus, G.M.; Mitsen, K.V.; Perepechko, I.I.; Karpinskii, O.G.; Shamray, V.F. (Lebedev Physics Institute, Moscow (USSR)). pp 883-888 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The temperature dependence of the elastic constants and lattice parameters of the $YBa_2Cu_3O_7$ samples were studied to find the mechanism responsible for the superconductivity of a new class of high-T/sub c/ superconducting oxides.

8316 **Point contact study of metal oxide superconductor Y-Ba-Cu-O.** Tulina, N.A.; Borodin, V.A.; Kondakov, V.F.; Chernyshova, L.I. (Institute of Solid State Physics, Moscow (USSR)). pp 889-892 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Point contacts were studied of ceramics with aluminum, copper, lead heterocontacts and of ceramics Y-Ba-Cu-O monocontacts have been studied. Current-voltage characteristics (CVC) and dynamic resistance dv/dI were taken versus the voltage applied to the point contact. Critical temperatures of the samples investigated varied within 88-95 K. According to the CVC behavior one can divide all the investigated point contacts into three groups: type I - the resistance R > 1K Omega, type II - 1K Omega > R > 10 Omega and type III - R < 10 Omega.

8317 **Infrared reflectivity, inelastic light scattering and energy gap in Y-Ba-Cu-O superconductors.** Bazhenov, A.V.; Gorbunov, A.V.; Klassen, N.V.; Kondakov, S.F.; Kukushkin, I.V.; Kulakovskii, V.D.; Misochko, O.V.; Timofeev, V.B.; Chernyshova, L.I.; Shepel, B.N. (Institute of Solid State Physics, Moscow (USSR)). pp 893-896 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Below 93K the spectra of FIR reflection and inelastic light scattering of Y-Ba-Cu-O samples reveal the peculiarities related with superconducting gap and optical phonons. The magnitude of the gap is found to be $2\Delta = (30 +/- 2)$ meV.

8318 **Specific features of microwave absorption of superconducting ceramics in a magnetic field.** Kveder, V.V.; Mchedlidze, T.R.; Ossipyan, Yu.A.; Shalynin, A.I. (Institute of Solid State Physics, Moscow (USSR)). pp 897-900 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Presently, different properties of ceramics on the base of metal oxide superconductors (Ba-Pb-Bi-O, Sr-La-Cu-O and Ba-Y-Cu-O) are being studied intensively. This work deals with the investigation of the microwave absorption in the Ba-Y-Cu-O base ceramics in the range of 9 GHz.

8319 **Low temperature x-ray analysis and electron microscopy of a new family of superconducting materials.** Ossipyan, Yu.A.; Borodin, V.A.; Goncharov, V.A.; Kondakov, S.F.; Khasanov, S.S.; Chernyshova, L.M.; Shekhtman, V.S.; Shmyt'ko, I.M.; Stchegolev, N.F. (Institute of Solid State Physics, Moscow (USSR)). pp 901-904 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Recent findings in the field of high temperature superconductivity require that structural aspects of the behavior of this class of materials be investigated in detail in a wide temperature interval. A series of superconducting ceramics on the base of lanthanum and yttrium oxides (La/sub 2-x/Sr/sub x/$CuO_4$; x = 0, 2 and YBaCuO) have been obtained in the solid state Physics Institute of the Academy of Sciences of the USSR. This paper presents the results of the analysis of powder and sintered materials, using X-ray diffractometers (DRON), scanning electron microscope and special devices, enabling the investigations to be carried out within 4.2 K - 573 K.

8320 **Microwave response of the superconducting $YBa_2Cu_3O$/sub 9-x/ ceramics.** Leviev, G.I.; Pogosov, V.G.; Trunin, M.R. (Institute of Solid State Physics, Moscow (USSR)). pp 905-908 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The interaction of the $YBa_2Cu_3O$/sub 9-x/ ceramics with the microwave field of frequency omega/$2\pi$ = 9,3 GHz has been studied experimentally in a wide range of temperatures. The superconducting transition was registered according to variation of the high-frequency conductivity of the sample. Radiation of the doubled 2 omega and tripled 3 omega frequencies was observed on increasing the amplitude of the alternating field. Temperature dependences of harmonics of the incident-wave intensities and of the external magnetic field have been investigated. Two mechanisms of nonlinearity, describing qualitatively the experimental results are proposed.

8321 **Crystal preparation of La/sub 1-x/M/sub x/$)_2CuO$/sub 4-δ/ (M=Sr and Ba) and discovery of magnetic superconductors Ln-Ba-Cu-O systems (Ln=Lanthanide atoms).** Hosoya, S.; Shamoto, S.; Onoda, M.; Sato, M. (Institute for Molecular Science, Okazaki (Japan)). pp 909-914 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The details of the preparation of single crystals of the high-T/sub c/ oxide superconductors are reported and also the method applied in finding the Ln-Ba-Cu-O systems is presented. The temperature dependence of the magnetic susceptibility above T/sub c/ clearly indicates the existence of $Ln^{3+}$ ions. In case of $ErBa_2Cu_3O$/sub 7-δ/, the effective moment of Er atoms is estimated to be 9.33 from the experiment, which should be compared with the expected value of 9.58 for $Er^{3+}$ ions.

8322 **Optical-reflectance study of the single-crystal superconductor (La/sub 1-x/Sr/sub x/$)_2CuO_4$.** Koide, T.; Fukutani, H.; Fujimori, A.; Suzuki, R.; Shidara, T.; Takahashi, T.; Hosoya, S.; Sato, M. (National Lab. for High Energy Physics, Ibaraki (Japan)). pp 915-918 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Room-temperature reflectance measurements are reported from 0.55 to 6 eV in a single crystal (La/sub 1-x/Sr/sub x/$)_2CuO_4$. The measured spectrum is Kramers-Kronig analyzed to obtain the dielectric function and related functions, and the result is discussed with reference to the electronic properties of the materials.

8323 **Single crystal x-ray diffraction study of (La/sub 1-x/M/sub x/$)_2CuO$/sub 4-δ/ (M=Sr and Ba), $La_2CuO$/sub 4-δ/ and $LnBa_2Cu_3O$/sub 7-δ/ (Ln=Y, Dy and Ho) systems.** Onoda, M.; Shamoto, S.; Sato, M.; Hosoya, S. (Okazaki National Research Institutes (Japan)). pp 919-926 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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In order to clarify detailed electronic and structural properties, experimental works on single crystals are quite important. This paper reports the results on detailed structure analyses of the various Ln-M-Cu-O systems, that is, (La/sub 1-x/M/sub x/$)_2CuO$/sub 4-δ/ (M=Sr and Ba), $La_2CuO$/sub 4-δ/ and $LnBa_2Cu_3O$/sub 7-δ/ (Ln=Y, Dy and H9) by x-ray four-circle diffraction, and on a relation between the structural and superconducting properties.

8324 **Single crystal studies and electron tunneling of (La/sub 1-x/M/sub x/$)_2CuO$/sub 4-δ/ (M=Ba and Sr).** Sato, M.; Shamoto, S.; Onoda, M.; Sera, M.; Fukuda, K.; Hosoya, S.; Akimitsu, J.; Ekino, T.; Imaeda, K. (Institute for Molecular Science, Okazaki (Japan)). pp 927-934 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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It is not easy to clarify what differences induce the large difference of the T/sub c/ values between the present high-T/sub c/ oxides and other conductive oxides. In order to extract certain information, it seemed necessary to study the detailed physical properties of the high-T/sub c/ oxides. Therefore, single crystals of these oxides were prepared. For (La/sub 1-x/M/sub x/$)_2CuO$/sub 4-δ/ M = (Sr and Ba), single crystals were obtained which exhibited superconductivity and studied various physical properties were studied using these crystals. As another important technique to extract the information on the unusually high-T/sub c/ superconductors, the electron tunneling where the superconducting energy gap can directly be observed. The present paper reports results from these experimental studies.

8325 **Study of superconducting at Westinghouse.** Braginski, A.I. (Westinghouse R & D Center, Pittsburgh, PA (USA)). pp 935-949 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Work at Westinghouse was aimed at determining technically important parameters of newly discovered oxide compounds. The authors did not participate in the race toward new compounds of even higher T's, although early experiments with fluorine substitutions might be construed as an indication to the contrary. Collaboration with Boeing Corporation resulted in a somewhat provocative structural determination which, if it can withstand further tests, might have important implications for understanding of superconductivity. Transport properties and carrier density determinations were of particular interest. As a consequence of joint work with NBS, the combination of J/sub c/ data derived from magnetization

and transport measurements, also supported by complex susceptibility results, contributed to the definition of the intergrain connectivity problem. It is intended to continue to investigate this problem in order to determine the feasibility of technically useful conductors operating at higher cryogenic temperatures up to 77K. Recently started film synthesis work will be directed at superconducting electronic applications.

8326 **Study of the preparation and properties of YBaCuO-films.** Haeuser, B.; Rogalla, H. (Universitaet Giessen (West Germany)). pp 951-959 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Room temperature deposition of YBaCuO-films by rf-magnetron sputtering from a sinter target yields thin films, which become superconducting after an appropriate oxygen annealing treatment. A first film of 150nm thickness shows an onset temperature of about 90K and a broad transition to full superconductivity at 12K. An optimization of this preparation method is currently performed in order to decrease the transition width for the very thin films.

8327 **Physical properties of high-temperature superconductors.** Huang, C.Y.; Dries, L.J.; Junga, F.A.; Hor, P.H.; Meng, R.L.; Chu, C.W. (Lock heed Missiles & Space Co., Inc., Palo Alto, CA (USA)). pp 961-967 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The authors have measured the magnetization of single-phase 90-K superconductors, $GdBa_2Cu_3O/sub\ 6+\delta/$, $EuBa_2Cu_3O/sub\ 6+\delta/$, and $SmBa_2Cu_3O/sub\ 6+\delta/$ with a SQUID magnetometer. They have shown that, in the superconducting state, each magnetization-field curve exhibits a maximum at ~ 100 G, followed by a linear increase of the magnetization with a slope only approximately one-fifth of the slope for a field smaller than 50 G. They have also investigated the effect of $\gamma$-irradiation on $YBa_2Cu_3O/sub\ 6+\delta/$, $SmBa_2Cu_3O/sub\ 6+\delta/$, and have found that the radiation damage results in the appearance of a tail in the superconducting transition. They have also shown that the normal resistance decreases with increasing radiation exposure up to a dose of 10 Mrad.

8328 **Resistance dependence and thermogravimetric analysis of the $Er_1Ba_2Cu_3O/sub\ 9-\delta/$ superconductor above room temperature.** Song, Y.; Golben, J.P.; Lee, S.; McMichael, R.D.; Chen, X.; Gaines, J.R. (Ohio State Univ., Columbus (USA)). pp 969-972 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Resistance and thermogravimetric analysis (TGA) measurements on $Er_1Ba_2Cu_3O/sub\ 9-\delta/$ are reported between room temperature and 920°C. The incorporation of oxygen into the furnace allows simulation of the whole sintering and annealing processes. Several resistive and oxygen content features are presented.

8329 **Anomalous resistive behavior in $Er_1Ba_2Cu_3O/sub\ 9-\delta/$ at 290 K.** Gaines, J.R.; Lee, S.; Golben, J.P.; Song, Y.; McMichael, R.D.; Chen, X.; Chittipeddi, S.; Selover, M.; Epstein, A.J. (Ohio State Univ., Columbus (USA)). pp 973-976 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The structure of the 1-2-3 compound $Y_1Ba_2CuO/sub\ 9-\delta/$ is not well established. The compound is stacked in a Ba-Y-Ba sequential cell, and contains a slight orthorhombic distortion, [8-12] possibly due to ordered oxygen vacancies. The oxygen content and degree of ordering in this compound is generally believed to be crucial to the superconducting mechanism. The high T/sub c/ observed for the fluorinated system of $Y_1Ba_2Cu_3O/sub\ 9-\delta/$ noted above can possibly be understood in terms of these phenomena. Resistive anomalies are reported near 290 K in Er Ba, $Cu_3O/sub\ 9-\delta/$ which are reproducible from sample to sample but time dependent. Oxygen deficiencies and structure may also play an important role in this compound.

8330 **Structure and the (014)/(005) x-ray line intensity in 1-2-3 superconductors.** Lee, S.; Golben, J.P.; Song, Y.; Chen, X.; McMichael, R.D.; Gaines, J.R. (Ohio State Univ., Columbus (USA)). pp 977-980 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Ordering to some extent beyond a random cubic phase must exist in $LaBa_2Cu_3O/sub\ 9-\delta/$ and $PrBa_2Cu_3O/sub\ 9-\delta/$ as evidenced by the finite intensity of the (014/(005) superlattice line. This line occurs in all of the 1-2-3 compounds, and seems to vary independently from sample to sample, while the other intensities in the spectrum change to a much lesser degree. An overview is presented of this (014)/(005) line intensity in these compounds. In a sense, that line us the internal structural indicators.

8331 **Measurement of fluctuation-enhanced conductivity above T/sub c/ in Y-Ba-Cu-O.** Dubson, M.A.; Calabrese, J.J.; Herbert, S.T.; Harris, D.C.; Patton, B.R.; Garland, J.C. (Ohio State Univ., Columbus (USA)). pp 981-982 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Careful measurements were made of the resistivity vs. temperature in a sample of polycrystalline $YBa_2Cu_3O/sub\ 7-\delta/$ and the data were fitted to a theoretical expression for the fluctuation-enhanced conductivity in the normal state. From this fit, a value was inferred for the zero-temperature Ginzberg-Landau coherence length zeta (0) of 21 +/5 5A.

8332 **Grain decoupling at low magnetic fields in ceramic $YBa_2Cu_3O/sub\ 7-\delta/$.** Kwak, J.F.; Venturini, E.L.; Ginley, D.S.; Fu, W. (Sandia National Labs., Albuquerque, NM (USA)). pp 983-991 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC04-76DP00789.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Results are reported of J/sub c/ and magnetization measurements versus magnetic field on ceramic $YBa_2Cu_3O/sub\ 7-\delta/$ in the superconducting state. The directly measured J/sub c/'s are several 100 $A/cm^2$ at 76 K in zero field. In a longitudinal field J/sub c/ falls very rapidly at low fields, dropping by a factor of 5 at 20 Oe and reaching essentially zero below 250 Oe. This field dependence was shown to be consistent with Josephson tunneling between grains. J/sub c/, despite its extrinsic nature was shown to give a sensitive measure of the bulk H/sub cl//sup c/' because of its extreme sensitivity to trapped flux.

8333 **Magnetization of superconducting Ba(Y, Nd, Sm, Gd, Dy, Er, Yb)CuO systems.** Nam, S.B.; Nam, S.W.; Nam, J.O. (Wright State Univ., Dayton, OH (USA)). pp 993-1002 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A summary report is presented of the study of various high Tc superconductors. The strategy was to test if the system were in the Meissner state. Magnetization was of primary concern. The observed magnetization can be understood in the frame work of the BCS theory. The $2\ \Delta\ (0)/k/sub\ \beta/$ Tc were deduced to be 3. = 4.4 (+/- .3) vin studying the magnetization near Tc. However, the magnetic hysteresis was found to be present even in a low field 30G at 10K. The magnetization was found to be sensitive to the thermal fluctuations near Tc. Various ideas of mechanisms for superconductivity in these systems are suggested.

8334 **Josephson effect and energy gap measurements from Nb/YBCO point contact structures.** Barone, A.; Di Chiara, A.; Peluso, G.; Scotti di Uccio, U.; Cucola, A.M.; Vaglio, R.; Matacotta, F.C.; Olzi, E. (Universita di Napoli, Naples (Italy)). pp 1003-1009 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Very reliable and stable point contact structures have been made by a Nb point pressed on a bulk high-T superconductor (Y $Ba_2Cu_3O_7$) by using a suitable apparatus. Current-voltage characteristics and dV/dI curves have been obtained showing both the occurrence and Josephson effect and providing an estimate of the gap of the YBCO.

8335 **Evidence of high energy excitations in high T/sub c/ superconductors.** Escudero, R.; Akachi, T.; Barrio, R.A.; Tagueena-Martinez, J. (Universidad Nacional Autonoma de Mexico). pp 1011-1016 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Tunneling experiments were performed in Y-Ba-Cu-O samples that show a granular composition that allow the measurements of differential resistance using a conventional modulation technique. Typical tunneling spectra are produced from the samples. These curves show clear structure that could be associated to excitations coupled to the tunneling electrons. The energies of these excitations are of the order of hundreds of millivolts, far to high to be due to phonons. It is not clear yet if these excitations play a role in the superconducting properties of the material. However, some theoretical ideas are presented in order to decide about the possibility for a new mechanism that couples electrons and causes superconductivity.

8336 **Structural and charge-transfer description of high-T/sub c/ superconductivity in $Y_1Ba_2Cu_3O$/sub 7-δ/.** Vezzoli, G.C.; Benfer, R.; Spurgeon, W. (Army Materials Technology Lab., Watertown, MA (USA)). pp 1017-1028 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The observation of high-T/sub c/ superconductivity is described in terms of the unique structure of the ceramic $Y_1Ba_2Cu_3O$/sub 7-δ/ and treated as a special defect case of the $A_2BX_4$ archtypes normally represented by $K_2MnF_4$ or $K_2NiF_4$. The recently elucidated structure of the ceramic superconductor (known as the 1-2-3 material) can be shown to be a substitutive distortion defect modification of the well-known antiferromagnetic $K_2NiF_4$ structure if it is written in the defect $A_1B_2X_4$ form ($Ba_2^{2+}$ $Cu_2^{2+}$)($Y_1^{3+}$ $Cu_1^{3+}$)O/sub 8-w/. This material is superconducting for $1 < w < 1.5$. The presence of the corner $Cu^{3+}$ in the basal planes of the 1-2-3 unit cell coupled with the linking region of an oxygen-vacancy, capable of forming an F center, and further influenced by the distorted square planar coordinated oxygens of the corner copper ions ($CuO_3$ units) allows for a mediation of BCS theory via exciton interactions, and influenced by a Jahn-Teller distortion. The edge $Cu^{2+}$ ions are hybridized in $CuO_2$ layers, and the five-fold coordination allows for a shared oxygen ion with the corner copper ions establishing an interactive element between a-b plane and the z axis.

8337 **Tunneling spectroscopy of high T/sub c/ oxide superconductors with a scanning tunneling microscope.** Pan, S.; Ng, K.W.; de Lozanne, A.L. (Univ. of Texas, Austin (USA)). pp 1029-1031 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A brief summary is presented of tunneling measurements on La/sub 1.85/Sr/sub 0.15/CuO/sub 4-y/ and $YBa_2Cu_3O$/sub 6.91/, including comments about preliminary results on the temperature dependence of the gap in the latter material. These were taken with a scanning tunneling microscope that operates at temperatures down to 10K in an ultra-high vacuum chamber.

8338 **Oxygen ordering and interfacial superconductivity at twin boundaries in Landau-Ginzburg superconductor oxide model.** Varea, C.; Robledo, A. (Universidad Nacional Autonoma de Mexico). pp 1033-1039 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The authors analyze the superconducting critical behavior of a model $YBa_2Cu_3O$/sub 9-y/ twinned orthorhombic crystal. For a Landau-Ginzburg free energy with coupled superconducting and oxygen-vacancy order parameters, the symmetry-breaking twin boundaries induce a purely interfacial superconducting transition at T/sub c//sup twin/ > T/sub co/, within a range of oxygen bulk compositions. Bulk superconductivity occurs at T < T/sub co/ below the oxygen-vacancy ordering temperature T/sub o/.

8339 **Superconductivity in YBa/sub 2-x/Sr/sub x/ $Cu_3O$/sub 7-y/ and Y/sub 1-x/Sr/sub x/CuO/sub 3-y/.** Mei, Y.; Green, S.M.; Jiang, C.; Luo, H.L. (Univ. of California, San Diego, La Jolla (USA)). pp 1041-1047 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Studies were conducted on YBa/sub 2-x/Sr/sub x/$Cu_3O$/sub 7-y/ for $0 \leqq x \leqq 2.0$. Single phase samples with T/sub c/ ~ 90K were obtained for $x \leqq 1.0$. Y/sub 1-x/Sr/sub x/CuO/sub 3-y/ was also studied for $0.1 \leqq x \leqq 0.8$. Surprisingly, for $x = 0.7$, they obtained the single-phase $K_2NiF_4$ structure with T/sub c/ ~ 40K.

8340 **Cu substitution into the La/Y site in La/sub 1.8/Sr/sub .2/$CuO_4$ and $YBa_2Cu_3O_7$: determination by x-ray absorption spectroscopy.** Lytle, F.W.; Greegor, R.B.; Panson, A.J. (Boeing Co., Seattle, WA (USA)). pp 1049-1060 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The Cu K-edge spectra from La/sub 1.8/Sr/sub .2/$CuO_4$ (LSC) and $YBa_2Cu_3O_7$ (YBC) are presented. They are obviously very similar to each other, i.e. the environment of Cu in each material must be similar. That the bond distances which cause the XANES peaks all arise from the Cu atom and average over all the different Cu-X bond distances due to different Cu sites in the material. The various XANES features may be identified with specific distances which have been determined by other techniques. Most of the expected Cu distances can be identified except for the one prominent peak at 25 eV, which is common to both LSC and YBC. This feature corresponds to a Cu-X distance of ~ 2.5 A. This distance is unique to the Y or La site and therefore a significant fraction of Cu must be in the Y/La site.

8341 **Hall effect in $YBa_2Cu_3O$/sub 7-x/ vs oxygen content x: observation of a sharp transition in R/sub H/ vs x.** Ong, N.P.; Wang, Z.Z.; Clayhold, J.; Tarascon, J.M.; Greene, L.H.; McKinnon, W.R. (Princeton Univ., NJ (USA)). pp 1061-1066 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

By changing the oxygen stoichiometry x of the superconducting perovskite $YBa_2Cu_3O$/sub 7-x/ they have found that a sharp transition in the Hall constant R/sub H/ occurs when the oxygen content is reduced by $\Delta x = 0.47 +/- 0.02$. At this value of $\Delta x$ the oxidation of the Cu ions has been reduced by one electron per unit cell. R/sub H/ is found to be temperature dependent for all samples studied. At 100 K the carrier density corresponds to 1/6 itinerant hole per Cu ion in the $\Delta x = 0$ sample. A discussion of the electronic structure is given.

8342 **Oxygen stoichiometry of $YBa_2Cu_3O$/sub 7-x/.** Steinfink, H.; Swinnea, J.S.; Manthiram, A.; Sui, Z.T.; Goodenough, J.B. (Univ. of Texas, Austin (USA)). pp 1067-1071 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

It is evident that the promise of the new high temperature ceramic superconductors will not be realized without an intense materials science and engineering effort focused on converting these oxide powders into useful bulk forms. The general limitations of the conventional press and sinter ceramic processing approach are likely to be amplified by the sensitivity of the superconductivity transitions of $YBa_2Cu_3O$/sub 7-x/ to oxygen content. The crystal structure of the superconducting phase has been determined from Rietveld refinement of powder neutron diffraction data and the tetragonal crystal structure of $YBa_2Cu_3O_8$ has been determined from single crystal x-ray diffraction data. The two structures are illustrated and the respective calculated x-ray powder diffraction patterns are shown. The extent of the orthorhombic and tetragonal phase fields are reported as a function of the oxygen composition.

8343 **Substitution for copper in high-T/sub c/ oxides.** Maeno, Y.; Fujita, T. (Hiroshima Univ. (Japan)). pp 1073-1082 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

It has not been definitely made clear yet which of the two Cu sites is essential for the occurrence of the high-T/sub c/ superconductivity in $YBa_2Cu_3O$/sub 7-δ/. In other words, it is not known whether the dimensionality (2D or 1D) or the reduced randomness intrinsic to the structure is crucial to the high-T/sub c/ superconductivity in $YBa_2Cu_3O$/sub 7-δ/. Complete replacement of Y, which is located adjacent to the Cu2-0 sheet, by various magnetic rare-earth (RE) ions leaves T/sub c/ essentially unchanged. Partial substitution of Sr at the Ba site, Y(Ba/sub 1-x/Sr/sub x/)$_2$CuO/sub 7-δ/, with the Sr concentration x up to 0.5 causes T/sub c/ to decrease by about 10 K. To discriminate which of the two Cu sites mainly carries superconducting electrons, it is to investigate the effects of direct substitution for Cu sites. The results of substitution for copper in $YBa_2Cu_3O$/sub 7-δ/ and (La/sub 1-x/Ba/sub x/)$_2$CuO/sub 4-δ/ are reviewed.

8344 **Superconductivity in pure $La_2CuO_4$.** Shaheen, S.A.; Jisrawi, N.; Min, Y.H.; Zhen, H.; Rebelsky, L.; Croft, M.; McLean, W.L.; Horn, S. (Rutgers, The State Univ. of New Jersey, Piscataway (USA)). pp 1083-1088 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Detailed investigations of the ground state properties of $La_2CuO_4$ have been made. Their data indicates traces of superconductivity in $La_2CuO_4$, with onset temperatures of 45K or higher. Results on three samples prepared from variable purity CuO (99.999%, 99.99%, 96%) indicate that superconductivity is an intrinsic property of $La_2CuO_4$ and not an artifact of impurity phase(s). Meisner signal as high as 0.3% has been observed. Indication for antiferromagnetic ordering near 210K is also apparent from both resistivity and magnetic susceptibility data.

8345 **Oxygen-Intercalation effect upon tetragonal-$LaBa_2Cu$/sub 3-x/O/sub y/.** Yoshizaki, R.; Sawada, H.; Iwazumi, T.; Saito, Y.; Abe, Y.; Ikeda, H.; Nakai, I. (Univ. of Tsukuba, Ibaraki (Japan)). pp 1089-1093 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

In the present study, semiconductor-to-superconductor transition has been found to occur in a tetragonal-$LaBa_2Cu$/sub 3-x/O/sub y/ compound by means of annealing the sample in $O_2$ atmosphere. In this compound a tetragonal form is stable to the oxygen intercalation by annealing. The atomic site of intercalated oxygens has been determined by a Rietveld analysis of X-ray powder diffraction patterns of the samples.

8346 **Electric-Field modulation of low electron density thin-film superconductors.** Hebard, A.F.; Fiory, A.T. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 9-22 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Past investigations of electric-field modulation of the normal-state and superconducting properties of thin films are reviewed and compared with recent work on amorphous-composite In/InO/sub x/ thin films with electron carrier density as low as $10^{20}$ $cm^{-3}$. Electric charge induced in the In/InO/sub x/ films by a capacitatively-coupled gate electrode has a particularly strong influence when the disorder (resistivity) is increased towards a critical value where superconductivity rapidly disappears. The experimentally-measured field-effect mobility, the unperturbed electron density, and the transition temperature are strongly dependent on oxide content, substrate material, and dielectric capping overlayers. The field-effect measurements confirm the importance of electronic states at the metal-dielectric interfaces and enable a description of interface dominated superconductivity in this and possibly other low electron density superconductors. Implications for the high T/sub c/ oxides are also presented.

8347 **Test of T/sub c/-predictions using the rigid band model for refractory compounds.** Haase, E.L.; Ruzicka, J. (Institut fuer Nukleare Festkoerperphysik, Karlsruhe (West Germany)). pp 39-46 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

B1-compounds are particularly suitable to test T/sub c/-predictions, as they form continuous solid solutions with intermediate properties reflecting the changing number of valence electrons (VE). Thin films of the Nb/sub 1-x/Mo/sub x/C, Nb/sub 1-x/Mo/sub x/C/sub 1-y/N/sub y/ and MoC/sub x/N/sub y/ systems were prepared by sputtering. There are serious discrepancies between theory and the experimental results. In particular, the predicted minimum at 10.45 VE was not observed. It was possible to prepare Nb/sub 0.3/Mo/sub 0.7/C with 9.7 VE stoichiometrically. Instead of the expected T/sub c/ of 17 K only 13 K was measured. In the NbC/sub 1-y/N/sub y/, Ti/sub 1-x/Nb/sub x/N and Ti/sub 1-x/Nb/sub x/C/sub 1-y/N/sub y/ systems for around 9.7 VE at T/sub c/ of up to 17.3 K is observed in agreement with theory. However, where theoretically a narrow maximum is predicted, high T/sub c/ values are observed for a wide range of VE.

8348 **Parameters and exotic properties of high T/sub c/ superconductors.** Kresin, V.Z.; Wolf, S.A. (Univ. of California, Berkeley (USA)). pp 287-291 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC03-76SF00098.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A method of determining the values of main parameters such as the effective mass, the Fermi energy, and the coherence length for the new high T/sub c/ superconductors is developed. The method is based on specific heat data. The new T/sub c/ materials are low dimensional systems and this feature plays a crucial role in the analysis. Particularly interesting is the small value of the Fermi energy. The result of the analysis shows that we are dealing with unusual systems. Energy gap appears to be comparable with E/sub F/, and the coherence length is small. Contrary to the usual case, the large fraction of carriers is paired.

8349 **Possible role of oxygen vacancies and excitonic mechanism in high T/sub c/ superconducting oxides.** Hsu, W.Y.; Kasowski, R.V. (E. I. du Pont de Nemours and Co., Wilmington, DE (USA)). pp 373-378 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Superconductivity with very high transition temperatures, T/sub c/, has been observed in pure and doped $La_2CuO$/sub 4-y/ and cuprate perovskites $ABa_2Cu_3O$/sub 7-y/ recently. These materials not only have unprecedented T/sub c/s but also other intriguing properties. For example, undoped $La_2CuO$/sub 4-y/ could be metallic, semimetallic, semiconducting, antiferromagnetic, or superconducting and likewise $YBa_2Cu_3O$/sub 7-y/ could be antiferromagnetic semiconducting, metallic with localized moments and superconducting, depending on how the samples are prepared. The key controlling factor appears to be the oxygen content of the materials. In a systematic investigation of the relationship between physical properties and oxygen vacancies in $La_2CuO$/sub 4-y/, Johnston et al observed the development of antiferromagnetic ordering from a non-magnetic ground state at $y = 0$ into a state with a Neel temperature of 290 K at $y = 0.03$. Electronic properties of oxygen vacancies in these cuprates are presented and their possible contribution to T/sub c/ is explored.

8350 **Displacive phase transformation in vanadium - substituted lanthanum niobate.** Aldred, A.T.; Chan, S.K.; Grimsditch, M.H.; Nevitt, M.V. (Argonne National Lab., IL (USA)). *Materials Research Society Symposia Proceedings;* **24**: 81-86(1984).

The displacive transformations in complex oxides of the type LaNb/sub 1-x/V/sub x/$O_4$ has been studied by x-ray diffraction and Raman scattering for $0 \leqq x < 0.3$. X-ray diffraction results indicate that the transformation from the tetragonal high temperature structure (C/sub 4h/$^6$) to the monoclinic low-temperature structure (C/sub 2h/$^6$) is higher than first order and that the transformation temperature T/sub c/ is depressed significantly by V substitution. Raman scattering results show that the force constant between the nearest (Nb, V)$O_4$ tetrahedral units behave uniquely compared to others. It softens at T/sub c/ as a function of composition and it also softens as a function of temperature as T/sub c/ is approached from above. 10 references, 2 figures, 2 tables.

## 3606 Other Materials

*REFER ALSO TO CITATION(S) 7222, 7247, 7377, 7449, 7524, 7528, 7559, 7608, 7608, 7623, 7712, 7778, 7779, 7997, 8033, 8033, 8174, 8214, 8216, 8229, 8231, 8246, 8250, 8259, 8285, 8489, 8537, 8537, 8564, 8611, 8616, 8644, 8674, 8675, 8730, 8780, 9088, 9138, 9282, 9347, 10100, 10130, 10143, 10147, 10161, 10181, 10196, 10203, 10204, 10206, 10214*

8351 **(AD-A—197343/7/XAB) Nuclear reactions in GaAs and Si and their role in the single-event upset problem. Final report.** McNulty, P.J. (Clarkson Univ., Potsdam, NY (USA)). 1988. 54p. NTIS, PC A04/MF A01.

Experiments were carried out to measure charge collection resulting from exposure of Rockwell Fat-FET test structures to alphas, heavy ions, and protons. The alpha and heavy-ion data were used to determine the dimensions of the sensitive volume following techniques outlined in Appendix A. Charge-collection measurements in Si PIN photodiodes were carried out. This represents the first test of the ability of the CUPID codes to handle partially depleted n-p junctions. Measurements were made with two devices. The UV-100 PIN photodiode from EG+G had a sensitive volume which was only partially depleted even at high voltages, the YAG 444 is fully depleted over its thickness (400 um) when fully biased but the depletion width is substantially reduced for low biases.

8352 **(AD-A—197529/1/XAB) Epitaxial III-V semiconductors for integrated electro-optics. Final report, 1 August 1986-30 April 1988.** Anderson, W.A.; Beachley, O.T.; Kwok, H.S.; Liu, P.L.; Wie, C.R. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). 14 Jun 1988. 27p. NTIS, PC A03/MF A01.

Research was conducted on the synthesis and evaluation of new organometallics (OM), growth of epitaxial layers by OMCVD and laser chemical vapor deposition (LCVD), laser interaction with materials, structural and chemical evaluation of epitaxial layers, electrical evaluation of epitaxial layers and radiation effects in semiconductors and insulators. New OM precursors were developed and used in OMCVD. New OM sources are considered for lower toxicity and more efficient reaction. For the first time, InSb was grown in CdTe by OMCVD. A quadrupole mass analyzer and low temperature luminescence were installed for in situ diagnostics. Laser interaction studies reveal the importance of tunneling ionization for carrier generation in low bandgap materials. Ion emission was measured from a metal surface due to laser irradiation. Ions were observed at low laser fluence and at a frequency corresponding to an energy less than the material work function. Rocking-curve studies of MBE-grown strained GaInAs on GaAs is the most-reliable technique for strains $< 0.3\%$. LO-TO splitting in ion-damaged GaAs has been explained by the effective ionic charge of the ion-beam-induced point defects. Deep-level transient spectroscopy studies of irradiated p-InP has revealed trap levels and annealing effects of importance in extraterrestrial applications. A Yb/p-InP device has shown good linearity and improved stability as a temperature sensor from 100-400K. Thin (150 A) oxides on Si for VLSI applications were found to be more radiation tolerant compared to thicker oxides.

8353 **(AD-A—197588/7/XAB) Microstructure effects on tensile properties of tungsten-nickel-iron composites.** Rabin, B.H.; German, R.M. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jun 1988. 11p. NTIS, PC A03/MF A01.

Pub. in Metallurgical Transactions A, Vol. 19A, 1523-1532(Jun 1988).

Tungsten-base alloy W-Ni-Fe or W-Ni-Cu metal-metal composites were produced by liquid phase sintering elemental powders. The alloys possess high density, strength, and ductility which makes them useful for several applications, including kinetic energy penetrators. The composite microstructure consists of nearly spherical grains of body-centered cubic tungsten surrounded by a solidified face-centered cubic matrix phase containing Ni, Fe, and W. Although polycrystalline tungsten normally is brittle at room temperature, the matrix imparts ductility to the composite. Controlled processing of heavy alloys containing 88 to 97% W resulted in high sintered densities and excellent bonding between the tungsten grains and matrix. For these alloys, deformation and fracture behavior were studied via slow-strain-rate tensile testing at room temperature. The flow stress increased and the fracture strain decreased with increasing tungsten content. During tensile testing, cracks formed on the surface of the specimens at tungsten-tungsten grain boundaries. The crack density increased with plastic strain and tungsten content. The surface cracks, though initially blunted by the matrix, eventually increased in density until catastrophic failure occurred.

8354 **(AD-A—197752/9/XAB) MBE growth, characterization, and electronic-device processing of HgCdTe, HgZnTe, related heterojunctions, and HgCdTe-CdTe superlattices. Annual report.** Faurie, J.P. (Illinois Univ., Chicago (USA)). 31 Dec 1987. 42p. NTIS, PC A03/MF A01.

A report is made on growth and characterization of high-quality HgCdTe epilayers, MBE growth and characterization of two-inch diameter p- and n-type Hg(1-x)Cd(X)Te films on GaAs(100) substrate. The n-type intrinsic and extrinsic doping is discussed. The incorporation of As was photo-assisted using a Nd-YAG pulsed laser. X-ray photoemission of Hg clusters on Hg(1-x)Cd(x)Te surfaces was studied. Direct measurement by XPS and electrical determination of HgTe-CdTe valence-band discontinuity give values of 300-400 meV at 300K. Silicon was used as a n-type dopant to grow a homojunction which electrical characteristics are presented here.

8355 **(AD-A—198052/3/XAB) Effect of high heating rate on the pyrolysis of polymeric and composite materials.** Boyle, M.E.; Cozzens, R.F.; McPherson, J.A. (Naval Research Lab., Washington, DC (USA)). 1988. 25p. NTIS, PC A03/MF A01.

The pyrolysis of a carbon/phenolic sample was investigated as a function of heating rate (from 0.167 K/sec to 30000 K/sec) and was modeled by assuming two mechanisms are operating: a process with a low energy of activation that dominates at low heating rates and a process with a high energy of activation that becomes important at high heating rates. Kinetic and modeling parameters for sample pyrolysis at each heating rate are reported and have been used to accurately reconstruct the sample thermographs. In addi-

tion, the high heating rate instrument/method is described in detail. In this work, the effect of bulk heating rates (ranging from 0.167 K/min to 30000 K/sec) on the pyrolysis of a carbon/phenolic composite material is reported.

8356 **(AD-A—198101/8/XAB) HgCdTe material optimization for carrier-lifetime maximization. Final technical report, 1 September 1986-30 April 1988.** Vydyanath, H.R. (Aerojet ElectroSystems Co., Azusa, CA (USA)). 14 Jul 1988. 71p. NTIS, PC A04/MF A01.

Hg(1-x)Cd(x)Te is a variable bandgap alloy semiconductor that has recently emerged to perhaps the single most-important infrared-detector material with extensive military and civilian applications. The minority-carrier lifetime in p-type base material for n(+)p photodiode structures is normally much below the radiative limit and is limited by the presence of Shockley-Read Centers, which are related to the presence of impurities and native defects in the material. In order to obtain photo diode performance close to the theoretical limits, it is essential to prepare mercury cadmium telluride material with carrier lifetime approaching radiative limit. This is possible only when the origin of the Shockley-Read Centers limiting the carrier lifetime is established and the material preparation conditions are optimized so that the concentration of these centers is reduced to a minimum. The goal of the program was to optimize the preparation conditions of the (Hg,Cd)Te material such that the carrier lifetime was maximized. Both undoped and doped crystals were investigated. To begin with, indium as an n-type dopant was investigated. At the end of the duration of the program, the material had been optimized so that the p-type carrier concentration can be controllably reproduced via anneals under well defined thermodynamic conditions, namely temperature and partial pressure of Hg., the behavior of indium-doped (Hg,Cd) Te was well established. Carrier-lifetime measurements were carried out in epitaxial HgCdTe films.

8357 **(AD-A—198368/3/XAB) Growth of HgZnTe layers by lpe technique. Final report.** Sher, A.; Tsigelman, A.; Eger, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1 Mar 1988. 47p. NTIS, PC A03/MF A01.

Solid-solution mixtures of a wide-band-gap II-VI compound with one constituent being the semimetal HgTe may be tuned to yield narrow-gap semiconductors, suitable for the fabrication of infrared (3 micro - 14 micro) photon detectors. Among this group of solid solutions, Hg1-xCdxTe is at present the most-commonly-used material for photon detectors. In spite of the scientific and technological achievements difficulties still exist, generally attributed to the instability of these alloys. Thus, theoretical prediction about the relative stability of Hg1-xZnxTe, reported recently, stimulated experimental research into the narrow band gap range of this solid solution. In the present work the LPE of Hg1-xZnxTe was studied, focusing on the evaluation of this technique as a tool for achieving epitaxial layers of the new material, the solid solution Hg1-xZnxTe, with morphological, crystalline and electrical properties comparable with those of HgCdTe epilayers. Mercury cadmium tellurides, Mercury zinc tellurides. (mjm)

8358 **(AD-A—198409/5/XAB) Defect reduction in epitaxial growth using superlattice buffer layers. Final report, 1 April 1985-31 March 1988.** Bedair, S.M. (North Carolina State Univ., Raleigh (USA). Dept. of Electrical and Computer Engineering). Jul 1988. 69p. NTIS, PC A04/MF A01.

Superlattice (SL) structures are both fundamental and technical interest. Two classes of superlattices were investigated. In the first class, the superlattice layers have lattice parameters that closely match those of the substrate, such as in the case of the AlGaAs-GaAs and InP 0.53Ga0.47As systems. In the second class, the strained-layer superlattice (SLS) (1), the alternating layers have lattice parameters that are different by a significant amount, but the layers are thin enough that the lattice mismatch is entirely accommodated by elastically straining the layers without the generation of misfit dislocations.

8359 **(AD-A—198614/0/XAB) Defects in high-mobility semiconductor systems and other low-dimensional heterostructures. Final technical report, 23 April 1987-23 April 1988.** Grimmeiss, G.G. (Lund Univ. (Sweden). Dept. of Solid State Physics). 12 May 1988. 58p. NTIS, PC A04/MF A01.

Experimental work funded under the subject contract was completed at the University of Lund during the period 23 Dec 1987 - 23 April 1988. The observed findings have now been assessed and interpreted, and the results are presented here in 3 parts. Part I describes research on the Pb center of oxidized silicon surfaces. This center provided an important test defect for inauguration of a new opto-electronic measurement system which was assembled at Fort Monmouth as part of the planned research. The Pb center is the most important defect in MOS integrated circuit technology. In addition to being of much interest in itself, it provides an excellent probe to test interface interactions with current carrier holes and electrons, and with overlying layers of other semiconductors or superconductors. The optical absorption thresholds of this center were determined by the initial slope method, and compared with electrical energies to yield the Franck-Condon configurational change--found to be in good accord with molecular orbital theory. The parameters measured here will be of direct application in study of high-Tc superconductor interactions with silicon substrates. Part II describes similar measurements on defects in GaAs. Defects in this compound semiconductor are much more difficult to characterize, primarily because the best technology--electron spin resonance--is not so widely applicable as in Si; thus the electrical data cannot be clearly associated with specific point defect structures.

8360 **(AD-A—198694/2/XAB) Micromechanisms of fatigue crack growth and fracture toughness in metal-matrix composites. Technical report, 31 October 1987-31 July 1988.** Davidson, D.L. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1988. 25p. (SWRI—06-8602/4). NTIS, PC A03/MF A01.

Fatigue crack-rate data for large cracks in 12 variations of particulate SiC-reinforced alloy composites were measured. Composites with seven different matrix alloys were tested, four of which were of precipitation-hardening compositions, and these were tested in both as-extruded and peak-aged conditions. Five of the materials were made by casting, ingot-metallurgical methods and two of the alloys by mechanical alloying, powder-metallurgical methods. For both manufacturing methods, primary fabrication was followed by hot extrusion.

8361 **(AD-A—198746/0/XAB) Engineering interfaces in metal-matrix composites (Volume 3). Final technical report.** Cornie, J.A. (Massachusetts Inst. of Tech., Cambridge (USA)). 10 Jun 1988. 369p. NTIS, PC A16/MF A01.

The critical energy-release rate for separation of thin coatings from their substrate can be determined accurately in many instances when the coatings are elastic, and are under a state of residual stress. When the thickness of such coatings reaches a critical value, so that the elastic strain energy per unit surface area in them equals the specific work of fracture of the interface, the coating will delaminate from the substrate in quasi-static equilibrium. Through analysis of such delaminations of SiC coatings from single crystal Si substrates and Pitch-55 carbon fibers, the intrinsic toughness of Si-SiC and C-SiC interfaces were determined.

8362 **(AD-A—198805/4/XAB) Radiation sensitivity of soluble polysilane derivatives: science and applications. Technical report.** Miller, R.D. (IBM Almaden Research Center, San Jose, CA (USA)). 1 Aug 1988. 54p. (TR—21). NTIS, PC A04/MF A01.

Polysilane derivatives have very unusual electronic properties associated with extensive sigma delocalization along the polymer backbone. Strong electronic transitions that depend on the nature of the substituents, the polymer molecular weight, and the conformation of the backbone appear in the UV. These materials are radiation sensitive and are degraded to lower molecular-weight fragments upon exposure to light and ionizing radiation. This review attempts to overview the nature of these radiation-induced processes and describes some potential applications primarily in the field of microlithography.

8363 **(AD-A—199055/5/XAB) Growth of gallium nitride films via the innovative technique of atomic-layer epitaxy. Annual progress report, 1 June 1987-31 May 1988.** Davis, R.F.; Paisley, M.J.; Sitar, Z. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Science and Engineering). 1 Jun 1988. 31p. (NCSU/MTE—2). NTIS, PC A03/MF A01.

Gallium nitride (GaN) is a wide-bandgap (3.45 eV at 300K) III-V compound semiconductor. The large direct bandgap and high electron-drift velocity of GaN are important properties in the performance of short-wavelength optical devices and high-power microwave devices. Immediate applications that would be greatly enhanced by the availability of GaN and/or Al/sub x/Ga/sub 1-x/N devices include threat warning systems (based on the ultraviolet (UV) emission from the exhaust plumes of missiles) and radar systems (which require high-power microwave generation). Important future applications for devices produced from these materials include blue and ultraviolet semiconductor lasers, blue-light-emitting diodes (LEDs) and high temperature electronic devices. This report discusses this material.

8364 **(AD-A—199263/5/XAB) Planar vias through $Si_3N_4$ fabricated by focused ion beam implantation.** Melngailis, J.; Herndon, T.O.; Shepard, M.; Lezec, H. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Jun 1988. 5p. (JA—6074). NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology, Vol. 6, No. 3, 1022-1028(May-Jun 1988).

Previous work has demonstrated that silicon implanted into Si3N4 at doses above $10^{17}$/sq. cm can render the insulator conducting. This has been proposed as a means of making planar vias. The authors report here on the use of a focused ion beam to make such planar vias in Si3N4, thus avoiding the need for resist or mask. Implants were carried out at a single energy, 160 keV, using Si(2+) ions or sequentially at two energies, 80 and 160 keV, using Si(+) and Si(2+) ions, respectively. Films of 0.25-micrometer-thick Si3N4 over Al metal were implanted. Then the upper layer was deposited, patterned, and the structure was sintered at 425 C for 30 min. The dose threshold for conduction was between 2 x $10^{17}$/sq. cm and 5 x $10^{17}$/sq.cm and depended on whether the 160-keV or the two-energy implants were carried out. Interconnects formed in areas 1.6 x 1.6 micrometers had resistances as low as 0.15 Ohm, while the minimum dimension implants, made with an unscanned beam in 6-12 s, had resistances of 1.5 to 5 Ohms. For vias exposed with doses below threshold, permanent conduction could be induced by breakdown at voltages well below those needed to break down unimplanted Si3N4. Even with the present state of technology, focused ion beam implantation appears to be a useful technique for making level-to-level interconnects through Si3N4 in limited, critical areas of devices.

8365 **(AD-A—199505/9/XAB) Research on semiconductors at cryogenic temperatures. Final report, 1 July 1985-18 June 1988.** Wagner, G.R.; Janocko, M.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 26 Jun 1988. 40p. NTIS, PC A03/MF A01.

The Hall mobility and magnetoresistance of selectivity doped heterostructures of SixGe1-x/Ge prepared by molecular beam epitaxy (MBE) were studied in the temperature range 1.5 < T < 300K. Either Al or B was used to dope the alloy p-type. Evidence was found in the B-doped samples with x = 0.5 that a 2DHG is formed in the Ge at the heterointerface. The mobility at T = 4.2K in a sample with an undoped alloy spacer layer of 4 nm was micro H = 3200 sq. cm./V-sec and in other samples was found to decrease with spacer layer thickness. Shubnikov-de Haas oscillations were observed at T = 1.5K with the magnetic field normal to the interface, but not with the field parallel to it. The oscillation period yields a surface charge density of 2 x 10 to the 12th/sq. cm. in reasonable agreement with the value of 3 x 10 to the 12th/sq. cm. obtained by Hall measurements.

8366 **(BNL—41815) Glancing angle EXAFS studies of Cu-Al thin film interfaces.** Chen, H.; Heald, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016;AS05-80ER10742. 3p. (CONF-8808149—5). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003614/JAW.

From 5. international conference on X-ray absorption fine structure; Seattle, WA, USA (21 Aug 1988).

The glancing angle EXAFS technique has been employed to study the initial reactions on Cu-Al thin film interfaces. Samples prepared under uhv and non-uhv conditions are compared. Preliminary data indicate that the uhv prepared interface has a larger amount of initial reaction than the non-uhv one. When annealed at 160{degree}C, the resulting compound formation at the interfaces of the two samples are different. 4 refs., 1 fig., 1 tab.

8367 **(CONF-880726—4) The structure of silver/germanium/selenium glass.** Dejus, R.J.; Susman, S.; Volin, K.J.; Price, D.L.; Montague, D.G. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003948/JAW.

From 4. international conference on structure of non-crystalline materials; Oxnard, CA, USA (18 Jul 1988).

The structure of the Ag/Ge/Se glass at nominal composition $Ag_4Ge_9Se_9$ has been studied by means of neutron diffraction. The structure is discussed in terms of the structure factor and the radial distribution function. The radial distribution function measures the coordination around an average atom; however, combined with other sources of information the nearest-neighbor coordination of the constituent atoms has been determined. Isotopic $^{107}Ag$ substitution was used to identify the Ag correlations. Results are compared with earlier results for $GeSe_2$ glass. 7 refs., 4 figs., 1 tab.

8368 **(CONF-881125—2) Microanalytical characterization of wear damage in an alumina-silicon carbide whisker composite.** Yust, C.S.; Allard, L.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003149/JAW.

From 3. international symposium on ceramic materials and components for engines; Las Vegas, NV, USA (27 Nov 1988).

Wear damage in a silicon carbide whisker-reinforced alumina composite resulting from unlubricated, self-mated, pin-on-disk sliding in air at 800{degree}C has been characterized using scanning Auger spectroscopy, transmission electron microscopy, and energy dispersive x-ray analysis. Using constant bearing pressure and sliding velocity, sliding for 2 km resulted in mild wear of the disk surface on which regions of silicon oxide were formed. At a sliding distance of 5 km, the wear rates measured still indicated mild wear, but pitting at the center of the disk wear track was observed. Subsurface damage of the alumina matrix beneath the disk wear track at 5 km sliding distance was characterized by transmission electron microscopy of cross sections. Wear debris observed on the wear surface was comprised of fine particulates of composition similar to that of the bulk material. The implications of the observations regarding wear mode and wear lifetime are discussed. 9 refs., 10 figs.

8369 **(DOE/CE/15282—T1) [Prepare and characterize polymer matrix composites for exfoliated graphite fibers]: Final technical report.** Chung, D.D.L. (Chung (Deborah), Pittsburgh, PA (USA)). 1 Aug 1988. Contract FG01-86CE15282. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002302/JAW.

This paper presents carbon fiber composites which are rendered flexible by the addition of exfoliated graphite. This new material comprises exfoliated graphite and carbon fibers disposed in separate portions of the structure, preferably in separate layers. Bonding the structure into a unitary mass is a binder, preferably thermosetting in nature, which impregnates the composite structure. 3 refs., 7 figs., 3 tabs.

8370 **(DOE/ER/45206—5) Basic studies of submicron layers of Nb-Al: Final report.** (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). [1988]. Contract FG02-85ER45206. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003817/JAW.

Recent work with powder metallurgy processed Nb-Al has shown that thin layers of extruded Nb and Al reacted at low temperatures can form superconducting Nb-Al with high superconducting transition temperatures well above that expected from the equilibrium phase diagram for Nb-Al with high critical current den-

sities. The basic mechanisms for the low temperature reaction and the importance of surface effects, impurities, and the dependence of layer thickness in Nb-Al have not been explored. The purpose of the research program was a basic study of model layered structures of Nb and Al in order to develop an understanding of the basic properties of low temperature reactions at the Nb/Al interface. The research employed bilayers and multilayers of Nb and Al. 1 tab.

8371 **(ESA-ESTL—76) Lubricating properties of magnetron sputtered MoS2.** Roberts, E.W. (European Space Tribology Lab., Risley (UK)). Oct 1987. 64p. (ESA-CR(P)—2624; ETN—88-93151). NTIS, PC A04/MF A01.

It is shown that the tribological quality of MoS2 lubricant films formed by magnetron sputtering is determined by the choice of sputtering conditions. By selecting the appropriate conditions, films of extremely low friction coefficient and high endurance (in vacuum) are obtained. Such MoS2 films, when applied to precision ball bearings, give the lowest torques (for the given test conditions) observed with dry lubricants. It is shown that bearing endurance (in vacuum) depends on cage type and that long endurances are possible when PTFE composite cages are employed with sputter coated raceways and balls. While high perforance obtains in vacuum, tests in air show a marked deterioration in lubricating qualities, due to the adsorption of water vapor on MoS2 surfaces. This occurs in two stages and corresponds to adsorption at two types of surface site. Friction is speed-dependent and load-dependent. Film quality is determined by its chemical composition, which is a function of deposition rate.

8372 **(FRNC-TH—3188) Heavy mediums and materials (physics of the condensed state). Study of disordered systems at low temperature. Specific heat measurement in neutron irradiated quartz.** De Sa, L. (Grenoble-1 Univ., 38 (France)). Sep 1987. 199p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756250/JAW.

Specific heat of neutron irradiated silicas presents characteristics evolving with radiation dose and is a good way to study properties of disordered systems. Results obtained and comparison with other experiments allow to follow amorphization and defects created by irradiation and raise hypothesis about the evolution of microscopic structure of these materials.

8373 **(IFUSP-P—700) Line shape and thermal Kinetics analysis of the Fe/sup 2+/ -band in Brazilian Green beryl.** Isotani, S.; Furtado, W.; Antonini, R.; Dias, O.L. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 40p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705091/JAW.

The optical absorption spectra study through isothermal treatments of the $\sigma$- and PI-polarized bands of Fe/sup 2+/-band is reported. It was shown a linear correlation between these bands through thermal treatments. Irradiation with $\gamma$-rays from /sup 60/ Co, showed the decrease of this band. The line shape analysis and the discussions lend us to assign the PI- and $\sigma$-polarized bands to Fe/sup 2+/ ions in the structural channels with and without neighbour water molecules, respectively. The kinetics analysis through a "bimolecular-like" model gives untrapping parameter with Arrhenius behavior. The retrapping and recombination parameters showed a behavior proportional to T/sup 1/2/ - T/sup 1/2//sub o/ which were explained from free electron distribution of velocities and minimum untrapped electron energy due to a potential barrier of the trap. The kinetics cut-off temperature, T/sub 0/, agrees with the previous experimental observation.

8374 **(IFUSP-P—704) Numerical integration method applied to the study of atomic hydrogen in a-Si: (H,O,N) and natural beryl decay kinetics.** Furtado, W.; Isotani, S.; Antonini, R.; Blak, A.R.; Pontuschka, W.M. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705094/JAW.

A method of data processing was developed and applied to the study of decay kinetics of interstitial atomic hydrogen (H/sup 0//sub i/)/sup 1/ in X-irradiated a-Si:(H,O,N)/sup 2/ and natural beryl. A system of differential kinetic equations was constructed considering multiple possible reactions. the solutions were evaluated by Runge-Kutta's method of numerical integration. It was assumed that the H/sup 0//sub i/ was produced by radiolytic irradiation of R-H type molecules and trapped at interstitial sites of both materials. The heating releases the H/sup 0/ which quickly is either retrapped, recombined with R-radical left in the matrix or combined with other H/sup 0/ atoms forming H/sub 2/ molecules. The parameters related to untrapping and recombination processes were found to obey Arrhenius law. On the other hand, the retrapping and H-/sub 2/ formation parameters were fit to a function proportional to T/sup 1/2/ - T/sup 1/2//sub o/, where at T/sub 0/ they vanish.

8375 **(INFO—0188) Gas and water permeability of concrete for reactor buildings small specimens. Small specimens.** Mills, R.H. (Toronto Univ., Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1986. 77p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705111/JAW.

The effect on permeability of artifical aging by drying shrinkage and by freeze-thaw was determined by observing mass transfer of gas and water under a pressure gradient. It was found that damage due to freeze-thaw was negligible but that cracking around aggregate caused by drying shrinkage resulted in significantly increased permeability to both gas and water. The absence of freeze-thaw damage was attributed to self-dessication. Since the concrete was not exposed to an external source of water, the chemical reaction was sustained by consumption of mixing water. The resulting air voids were, apparently, sufficient to absorb expansive pressures due to ice formation. The response to lateral prestress was different for cracked and uncracked concrete. Although, in all cases, increased prestress resulted in reduced leakage, the effect was stronger in cracked concrete. Mean pore diameter as determined by gas diffusion was not, however, substantially affected because the leakage in cracked concrete remained very low. Reinforcing steel did not have a great influence on permeability of small specimens. Gas transmission through concrete was strongly influenced by moisture content. Free moisture constituted a barrier to gas flow, acting as a virtual solid. This is important since aging of concrete results in reduced free moisture. Ultrasonic pulse velocity appeared to vary with moisture content and porosity of concrete in the same way as gas permeability and gave promise of being effective for in-situ monitoring of concrete in reactor buildings.

8376 **(INFO—0188-2) Gas and water permeability of concrete for reactor buildings--prototype scale specimens.** Mills, R.H. (Toronto Univ., Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Feb 1987. 104p. NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705112/JAW.

The permeability testing was performed on four concrete cylinders, 0.25 m in diameter and 2 m long, modelling the wall-thickness of reactor containment structures on the prototype scale. Tests were performed on the cylinders before and after artificial induction of longitudinal cracks, intented to model defects developing after some period of adverse service conditions. Permeability increased greatly with the introduction of longitudinal cracks in the concrete, and was also affected by moisture content and casting direction. The influence of reinforcing steel could not be resolved within the bounds of experimental variability. Ultrasound measurements were taken on each cylinder before and after cracking, and a correlation between increased permeability and lowered Ultrasonic Pulse Velocity was observed. Ultrasonic Pulse Velocity measurements thus show promise as a means of continuous monitoring of the integrity of the concrete barrier in service.

8377 (INIS-mf—11327, pp 18) **Quantum effects in semiconductor components.** Dorda, G. (Siemens A.G., Muenchen (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

8378 (INIS-SU—56, pp 23-26) **Study of in-pile and out-of-pile corrosion behaviour of graphite.** Gerasimov, O.Yu.; Kuzmichev, V.A.; Zherdev, F.F.; Zhevakin, V.V.; Prokhorov, A.F.; Romanov, V.I.; Chabak, A.F.; Platonov, P.A. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

Using cylindrical specimens of GR-280 reactor graphite mass losses as a result of corrosion in helium atmosphere and the composition and concentration of reaction products in the gas-carrier were studied in the 300-1050 deg C temperature range. It is shown that the mass loss of specimens is caused by superposition of results of two reactions C + H/sub 2/O = CO + H/sub 2/ and C + O/sub 2/ = CO/sub 2/. Four temperature ranges characterized by the relevant reaction rates are singled out. The obtained results can be used for estimating graphite mass transfer in high-temperature interaction with H/sub 2/O impurities in helium. In the MR reactor at stepwise power elevation the impurity concentrations in the helium coolant increased as a result of impurity desorption from spherical fuel elements and their interaction between each other, with fuel element carbon and core construction materials. 3 figs.; 3 tabs.

8379 (INIS-SU—57/A, pp 34-36) **Continuous control of parameters of production of phosphogypsum binder.** Ksenofontov, V.G.; Prikhod'ko, V.A.; Kornev, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.

In Designing and building. Scientific-technical collection.

Choice of basic technological parameters for production of phosphogypsum binder of $\beta$-modification is substantiated. The necessity of their continuous control is shown. Control methods and hardware of the main parameters permitting to use them for following control automation of $\beta$-gypsum production are suggested.

8380 (INIS-SU—57/A, pp 29-33) **High-strength shielding hydrate concrete with chemical additions.** Panchenko, V.P.; Petinov, V.I.; Kochergin, V.D.; Likholetov, O.D. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.

In Designing and building. Scientific-technical collection.

Strength and deformation properties of high-strength shielding concretes type 500 and higher on the basis of serpentinite filler with special chemical and plasticized additions after setting under water and heat treatment are investigated. The opportunity of concrete utilization at the temperature up to 673 K is established. 5 refs.; 3 figs.

8381 (INIS-SU—63, pp 41-46) **Structural changes in carbon condensates during heating in vacuum.** Vakula, S.I.; Kunchenko, V.V.; Ostapenko, L.I.; Strel'nitskij, V.E. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Investigation of structural transformations in diamond-like carbon condensates, obtained by vacuum-plasma technology at their thermal heating in vacuum, is carried out by electron microscopy, microdiffraction and optical spectroscopy. It is established, that at condensate annealing at initial stage (T=673...873 K) the ordering of amorphous fields with trigonal and tetrahedral short-range order, mainly, takes place. The ordering of clusters with tetrahedral structure results in the formation of crystalline precipitations with fcc-lattice (a=0.36 nm), with size up to 25 nm...35 nm. Later on with annealing temperature increase the intensification of condensate graphitization degree with turbostratic graphite formation is observed. At T=1273 K graphitization captures all structural components of carbon film; packs of turbostratic graphite disordered along C axis of hexagonal lattices are set up parallel to substrate surface. Crystal structure with fcc-lattice undergoes decomposition, and dendritic crystals of graphite and CVI phase are formed.

8382 (INIS-SU—63, pp 76-78) **Deformation processes in irradiated crystals with ionic and ionic-covalent bonds.** Kolontsova, E.V.; Pogosova, I.S.; Red'ko, S.V.; Telegina, I.V. (Moskovskij Gosudarstvennyj Univ. (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

Radiation and deformation effects in monocrystals of alkali-haloid compounds, nitrates and oxides, irradiated by neutrons, electrons, $\gamma$ and X-quanta, are studied by X-ray diffraction methods. Results on relaxation of stresses, occuring at charge accumulation under irradiation, on deformation realization in the irradiated crystals due to the formation of point defects large clusters and precipitation of chemical decomposition products are presented. Interrelation between deformation dose dependence and, as consequence, the irradiation conditions, such as bombarding particles energy, flux intensity and irradiation temperature, is established. It is pointed out, that some radiation defects and monocrystal fragmentation, caused by deformation accompanying irradiation, experimentally have alike qualitative manifestation.

8383 (IPPJ—866, pp 228-233) **Neutron irradiation aspect of graphite and C-C composite materials.** Miyahara, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

The resistance against radiation damage is an important requirement for the materials facing plasma, although it has not been treated so far as the first priority problem, because the feasibility under high heat flux condition must be solved first. After the construction of such large tokamaks as TFTR, JET and JT-60, many investigations have been done to evaluate the various candidate materials facing plasma, and now iso-graphite and C-C composite were picked as the best materials for tokamaks without nuclear reaction and burning. Now, the feasibility of graphite and C-C composite under 14 MeV neutron irradiation environment must be evaluated. The key properties in applying bulk graphite to CIT and ETR are heat conductivity, thermal expansion, degasing, strength and fracture toughness, and the data on the irradiation effect of these properties are available for CIT condition, but not always applicable to ETR. The apparent advantage of carbon fiber-carbon matrix structures for fusion energy application is obvious. The serious problem is the ability to withstand the damage due to 14 MeV neutrons. C-C composite must be investigated under CIT and ITER irradiation conditions. The international effort should be developed in view of efficiency and cost to execute the research. (Kako, I.).

8384 **(JAERI-M—88-178) Methodology study on qualification testing of wire and cable for nuclear power plant. Study on degradation of insulating materials under LOCA environments by using SEAMATE-II.** Kusama, Yasuo; Okada, Sohei; Yagi, Toshiaki and others. (Japan Atomic Energy Research Inst., Takasaki, Gunma. Takasaki Radiation Chemistry Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1988. 391p. (In Japanese). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88756064/JAW.

In order to evaluate validity of the present qualification methodology of class 1E electric wires and cables used for nuclear power plants, effect of irradiation and steam exposure conditions in both simulated simultaneous and sequential LOCA tests on the degradation of insulating and jacketing materials of wires and cables have been investigated by using the Simulated Environmental Apparatus for MAterial TEsting-II (SEAMATE-II). In LOCA environments without air, degradation of the materials were almost the same for simultaneous and sequential methods. In aircontaining simultaneous LOCA environments, the remarkable dose rate and steam temperature effects were found on mechanical and electrical properties and water sorption of the materials, and the larger damage was observed compared with those in the sequential environments. Increasing and decreasing rate of temperature in a tran-

sient period, spray and aging conditions had small effects on degradation of the materials. In sequential LOCA environments, pre-irradiation dose rate and environments affected strongly on the degradation, and these effects became obvious under the presence of air in steam/spray exposure. Further, aging conditions and spray were shown to have small effects on the degradation. (author) 57 refs. 265 figs. 45 tabs.

8385 **(JAERI-M—88-185) Properties of water leakage through concrete slabs with a parallel gap.** Shimooka, Kenji; Abe, Mikiya. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756067/JAW.

This paper describes the experimental results of water flow in concrete crack, in order to get the fundamental data on the barrier effect of the concrete material on the nuclide migration. Concrete slabs with a parallel gap, instead of the unidentified native cracks were used in the experiment and the water leakage through the certain gap was studied in detail. It is recognized that the water flow through cracks can be generally treated as a laminar flow, thus the theoretical equation derived from Navier-Stokes equation can be applied in the flow analysis. According to the theory, the amount of water flow through the crack is described to be proportional both to the third power of crack width and to the pressure gradient, and also to be inversely proportional to the coefficient of water viscosity. We have confirmed that the equation can be applied to the water flow through even 0.01 cm width gap in concrete by the experiments, measurement of the water flow under the conditions of constant head and gradually changing temperatures and also at the constant temperatures.

8386 **(Juel—2189) Electron spectroscopy in the X-ray range for occupied and free levels and the application to transition metal silicides.** Speier, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Koeln Univ. (Germany, F.R.)). Mar 1988. 125p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755963/JAW.

Intermetallic compounds of transition metals are investigated by means of XPS, Bremsstrahlung Isochromate Spectroscopy and XAS. Occupied and free levels are characterized and moreover a systematic overview over the electronic structure of the transition element silicides is given. (BHO).

8387 **(LBL—25780) Suppression of defect propagation in heteroepitaxial structures by strained layer superlattices.** Liliental-Weber, Z.; Weber, E.R.; Washburn, J.; Liu, T.Y.; Kroemer, H. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 10p. (CONF-8805222—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002955/JAW.

From NATO advanced study institute workshop - heterostructures on Si: one step further with silicon; Cargese, France (15 May 1988).

Defects present in GaAs on Si(211) heteroepitaxial layers grown by MBE have been analyzed in detail by TEM. Efficient reduction of dislocation propagation by strained layer superlattices was found. The mechanisms of defect reduction were suggested based on Burgers vector analysis. It was shown that additional threading dislocations can glide into the epilayer during cooling process and that misfit dislocations at the interface can be forced to dissociate on a 111 plane inclined to the interface leaving one partial dislocation at the interface and forming extended stacking faults. 15 refs., 7 figs.

8388 **(N—88-28980) Investigation of a SiC/Ti-24Al-11Nb composite.** Brindley, P.K.; Bartolotta, P.A.; Klima, S.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 30p. (NASA-TM—100956; E—4253; NAS—1.15:100956; CONF-880126—). NTIS, PC A03/MF A01.

From TMS-AIME/ASM symposium on high temperature mechanical properties of ordered intermetallics; Phoenix, AZ, USA (25 Jan 1988).

A summary of ongoing research on the characterization of a continuous fiber reinforced SiC/Ti-24Al-11Nb (at percent) composite is presented. The powder metallurgy fabrication technique is described as are the nondestructive evaluation results of the as-fabricated composite plates. Tensile properties of the SiC fiber, the matrix material, and the 0-deg SiC/Ti-24Al-11Nb composite (fibers oriented unidirectionally, parallel to the loading axis) from room temperature to 1100 C are presented and discussed with regard to the resultant fractography. The as-fabricated fiber-matrix interface has been examined by scanning transmission electron microscopy and the compounds present in the reaction zone have been identified. Fiber-matrix interaction and stability of the matrix near the fiber is characterized at 815, 985, and 1200 C from 1 to 500 hr. Measurements of the fiber-matrix reaction, the loss of C-rich coating from the surface of the SiC fiber, and the growth of the Beta depleted zone in the matrix adjacent to the fiber are presented. These data and the difference in coefficient of thermal expansion between the fiber and the matrix are discussed in terms of their likely effects on mechanical properties.

8389 **(N—88-29880) Test for interfacial effects and stress transfer in ceramic matrix composites. Final report.** Bascom, W.D.; Lee, I. (Utah Univ., Salt Lake City (USA)). Aug 1988. 17p. (NASA-CR—182873; NAS—1.26:182873). NTIS, PC A03/MF A01.

The efforts to fabricate single embedded filament specimens of carbon and SiC fibers were unsuccessful largely due to the thermal stresses resulting from differences in thermal coefficient of expansion. Other factors appear to have been involved including embrittlement of the metal substrate by the $H_2$ gas in the chemical vapor deposition flow stream and reaction layers formed between the silicon carbide and the metal substrate. The carbon fiber may have been attacked by the CVD reactant. It is concluded that these differential stresses are so large as to make the embedded fiber test impractical for the study of interphase effects and stress transfer in fiber ceramic matrix systems.

8390 **(N—88-29884) Analytical study of graphite-epoxy tube response to thermal loads.** Knott, T.W.; Hyer, M.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Sep 1988. 85p. (NASA-CR—183215; NAS—1.26:183215; CCMS—88-16; VPI-E—88-25). NTIS, PC A05/MF A01.

The thermally-induced stresses and deformations in graphite-epoxy tubes with aluminum foil bonded to both inner and outer surfaces, and to the outer surface only are computed. Tubes fabricated from three material systems, T300/934, P75s/934, and P75s/BP907, and having a 1 inch inner radius and a lamination sequence of (+15/0 + or - 10/0)sub s are studied. Radial, axial, and circumferential stresses in the various layers of the tube, in the foil, and in the adhesive bonding the foil to the tubes are computed using an elasticity solution. The results indicate that the coatings have no detrimental effect on the stress state in the tube, particularly those stresses that lead to microcracking. The addition of the aluminum foil does, however, significantly influence the axial expansion of the T300/934 tube, the tube with the softer graphite fibers. The addition of foil can change the sign of the axial coefficient of thermal expansion. Twist tendencies of the tubes are only slightly affected by the addition of the coatings, but are of second order compared to the axial response.

8391 **(N—88-30113) Growth and characterization of materials for tunable lasers in the near infrared spectral region. Semiannual progress report, 1 February-31 July 1988.** Powell, R.C.; Martin, J.J. (Oklahoma State Univ., Stillwater (USA)). Jul 1988. 25p. (NASA-CR—183132; NAS—1.26:183132). NTIS, PC A03/MF A01.

During this reporting period, work proceeded in two directions. The first was the development of crystal growth procedures for rare earth doped LiYF4 crystals. The procedures for growth and pre-growth treatment of starting materials for undoped LiYF4 crystals were established and good optical quality materials were grown. A significant amount of time was spent trying to establish the optimum growth parameters for Yb(3+)-doped crystals. Unfortunately, it has proven difficult to obtain large size boules of high

optical quality crystals of LiYF4 with doping concentrations of Yb(3+) of several percent. Because of these problems, this research is to be changed to attempt doping with other trivalent rare earth ions such as Ho, Er, and Tm. The second research area was investigating the potential of LiNbO3:Mg,Cr and LiNbO3:Mg,Cr,Yb as possible laser materials. The results are summarized.

8392 **(N—88-30427) X-ray diffraction imaging (topography) of electrooptic crystals by synchrotron radiation.** Steiner, B.; Kuriyama, M.; Dobbyn, R.C.; Laor, U. (National Bureau of Standards, Washington, DC (USA)). 1988. 16p. (NASA-CR—183266; NAS—1.26:183266). NTIS, PC A03/MF A01.

Information of special interest to crystal growers and device physicists now available from monochromatic synchrotron diffraction imaging (topography) is reviewed. Illustrations are taken from a variety of electro-optic crystals. Aspects of the detailed understanding of crystal growth processes obtainable from carefully selected samples are described. Finally, new experimental opportunities now available for exploitation are indicated.

8393 **(N—88-30431) Diffraction imaging (topography) with monochromatic synchrotron radiation.** Steiner, B.; Kuriyama, M.; Dobbyn, R.C.; Laor, U. (National Bureau of Standards, Washington, DC (USA)). 1988. 50p. (NASA-CR—183264; NAS—1.26:183264). NTIS, PC A03/MF A01.

Structural information of special interest to crystal growers and device physicists is now available from high resolution monochromatic synchrotron diffraction imaging (topography). In the review, the importance of superior resolution in momentum transfer and in space is described, and illustrations are taken from a variety of crystals: gallium arsenide, cadmium telluride, mercuric iodide, bismuth silicon oxide, and lithium niobate. The identification and understanding of local variations in crystal growth processes are shown. Finally, new experimental opportunities now available for exploitation are indicated.

8394 **(N—88-30437) Streaking images that appear only in the plane of diffraction in undoped GaAs single crystals: diffraction imaging (topography) by monochromatic synchrotron radiation.** Kuriyama, M.; Steiner, B.; Dobbyn, R.C.; Laor, U.; Larson, D.; Brown, M. (National Bureau of Standards, Washington, DC (USA)). 1988. 20p. (NASA-CR—183267; NAS—1.26:183267). NTIS, PC A03/MF A01.

Streaking images restricted to the direction of the diffraction (scattering) vector have been observed on transmission through undoped GaAs. These disruption images (caused by the reduction of diffraction in the direction of observation) appear both in the forward and in Bragg diffracted directions in monochromatic synchrontron radiation diffraction imaging. This previously unobserved phenomenon can be explained in terms of planar defects (interfaces) or platelets which affects the absorption coefficient in anomalous transmission. Such regions of the crystal look perfect despite the presence of imperfections when the scattering vector is not perpendicular to the normal of the platelets. The observed crystallographic orientation of these interfaces strongly indicates that they are antiphase boundaries.

8395 **(N—89-10125) Fracture criteria for discontinuously reinforced metal matrix composites. Semiannual report, 16 February-15 August 1988.** Rack, H.J.; Goree, J.G.; Albritton, J.; Ratnaparkhi, P. (Clemson Univ., SC (USA)). Oct 1988. 152p. (NASA-CR—181175; NAS—1.26:181175). NTIS, PC A08/MF A01.

Summarized is the progress achieved during the period September 16, 1987 to August 15, 1988 on NASA Grant NAG1-724, Fracture Criteria for Discontinuously Reinforced Metal Matrix Composites. Appended are copies of three manuscripts prepared under NASA funding during the performance period.

8396 **(N—89-10128) Thermodynamic analysis of compatibility of several reinforcement materials with FeAl alloys.** Misra, A.K. (Case Western Reserve Univ., Cleveland, OH (USA)). Oct 1988. 30p. (NASA-CR—4172; NAS—1.26:4172). NTIS, PC A03/MF A01.

Chemical compatibility of several reinforcement materials with FeAl alloys within the concentration range 40 to 50 at pct Al have been analyzed from thermodynamic considerations at 1173 and 1273 K. The reinforcement materials considered in this study include carbides, borides, oxides, nitrides, and silicides. Although several chemically compatible reinforcement materials are identified, the coefficients of thermal expansion for none of these materials match closely with that of FeAl alloys and this might pose serious problems in the design of composite systems based on FeAl alloys.

8397 **(N—89-10131) Thermodynamic analysis of compatibility of several reinforcement materials with beta phase NiAl alloys. Final report.** Misra, A.K. (Case Western Reserve Univ., Cleveland, OH (USA)). Nov 1988. 60p. (NASA-CR—4171; E—4299; NAS—1.26:4171). NTIS, PC A04/MF A01.

Chemical compatibility of several reinforcement materials with beta phase NiAl alloys within the concentration range 40 to 50 at. percent Al have been analyzed from thermodynamic considerations at 1373 and 1573 K. The reinforcement materials considered in this study include carbides, borides, oxides, nitrides, beryllides, and silicides. Thermodynamic data for NiAl alloys have been reviewed and activity of Ni and Al in the beta phase have been derived at 1373 and 1573 K. Criteria for chemical compatibility between the reinforcement material and the matrix have been defined and several chemically compatible reinforcement materials have been defined.

8398 **(N—89-10134) Thermal effects on the mechanical properties of SiC fiber reinforced reaction bonded silicon nitride matrix (SiC/RBSN) composites.** Bhatt, R.T.; Phillips, R.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1988. 17p. (NASA-TM—101348; E—4375; NAS—1.15:101348; AVSCOM-TR—88-C-028). NTIS, PC A03/MF A01.

The elevated temperature four-point flexural strength and the room temperature tensile and flexural strength properties after thermal shock were measured for ceramic composites consisting of 30 vol pct uniaxially aligned 142 micron diameter SiC fibers in a reaction bonded Si3N4 matrix. The elevated temperature strengths were measured after 15 min of exposure in air at temperatures to 1400 C. Thermal shock treatment was accomplished by heating the composite in air for 15 min at temperatures to 1200 C and then quenching in water at 25 C. The results indicate no significant loss in strength properties either at temperature or after thermal shock when compared with the strength data for composites in the as-fabricated condition.

8399 **(N—89-10952) Laminate behavior for SiC fiber-reinforced reaction-bonded silicon nitride matrix composites.** Rhatt, R.T.; Phillips, R.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1988. 40p. (NASA-TM—101350; E—4377; NAS—1.15:101350; AVSCOM-TR—88-C-30). NTIS, PC A03/MF A01.

The room temperature mechanical properties of SiC fiber reinforced reaction-bonded silicon nitride matrix composite laminates (SiC/RBSN) have been measured. The laminates contained approx 30 volume fraction of aligned 142-micron diameter SiC fiber in a porous RBSN matrix. Three types of laminate studied were unidirectional: (1) (0) sub 8, (2) (10) sub 8, and (3) (45) sub 8, and (90) sub 8; cross plied laminates (0 sub 2/90 sub 2); and angle plied laminates: (+45 sub 2/-45 sub 2). Each laminate contained eight fiber plies. Results of the unidirectionally reinforced composites tested at various angles to the reinforcement direction indicate large anisotropy in in-plane properties. In addition, strength properties of these composites along the fiber direction were independent of specimen gage length and were unaffected by notches normal to the fiber direction. Splitting parallel to the fiber at the notch tip appears to be the dominant crack blunting mechanism responsible for notch insensitive behavior of these composites. In-plane properties of the composites can be improved by 2-D laminate construction. Mechanical property results for (0 sub 2/90 sub 2)sub s and (+45/-45 sub 2) sub s laminates showed that their matrix failure strains were

similar to that for (0) sub 8 laminates, but their primary elastic moduli, matrix cracking strengths, and ultimate composite strengths were lower. The elastic properties of unidirectional, cross-ply, and angle-ply composites can be predicted from modified constitutive equations and laminate theory. Further improvements in laminate properties may be achieved by reducing the matrix porosity and by optimizing the bond strength between the SiC fiber and RBSN matrix.

8400 **(N—89-11595) Structural anomalies in undoped Gallium Arsenide observed in high resolution diffraction imaging with monochromatic synchrotron radiation.** Steiner, B.; Kuriyama, M.; Dobbyn, R.C.; Laor, U.; Larson, D.; Brown, M. (National Bureau of Standards, Washington, DC (USA)). 1988. 48p. (NASA-CR—183268; NAS—1.26:183268). NTIS, PC A03/MF A01.

Novel, streak-like disruption features restricted to the plane of diffraction have recently been observed in images obtained by synchrotron radiation diffraction from undoped, semi-insulating gallium arsenide crystals. These features were identified as ensembles of very thin platelets or interfaces lying in (110) planes, and a structural model consisting of antiphase domain boundaries was proposed. We report here the other principal features observed in high resolution monochromatic synchrotron radiation diffraction images: (quasi) cellular structure; linear, very low-angle subgrain boundaries in (110) directions, and surface stripes in a (110) direction. In addition, we report systematic differences in the acceptance angle for images involving various diffraction vectors. When these observations are considered together, a unifying picture emerges. The presence of ensembles of thin (110) antiphase platelet regions or boundaries is generally consistent not only with the streak-like diffraction features but with the other features reported here as well. For the formation of such regions we propose two mechanisms, operating in parallel, that appear to be consistent with the various defect features observed by a variety of techniques.

8401 **(NIPER—360) High-temperature heat-capacity measurements and critical property determinations using a differential scanning calorimeter (development of methodology and application to pure organic compounds): Topical report.** Steele, W.V.; Chirico, R.D.; Knipmeyer, S.E.; Smith, N.K. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1988. Contract FC22-83FE60149. 33p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88001241/JAW.

This report outlines research at NIPER into the design of a fast, accurate, and precise method to determine the enthalpy for organic compounds and mixtures from ambient to the critical temperature, or in the case of a multi-component system, pseudo-critical point. The apparatus consists of a commercially available Differential Scanning Calorimeter (DCS) and specially designed sample cells capable of withstanding both high temperature and pressure without rupture. The report also outlines the determination of critical properties from the measurements made in this research. The results obtained in this research for benzene and decane are sufficient to prove the concept of using the differential scanning calorimeter with high-pressure cells to perform enthalpy and critical property measurements with good accuracy and precision. It is possible to use the temperatures at which conversion to a single phase occurs for several different cell fillings to map out the two-phase domain for a given compound.

8402 **(PB—89-105340/XAB) Mechanical properties of SiC-Wwhisker-reinforced aluminum-alloy-matrix composites.** Hattori, T.; Sakai, S. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1988. 6p. NTIS, PC E06/MF A01.

Text in Japanese; Included in Mitsubishi Juko Giho, Vol. 25, No. 4, 357-361(1988).

The mechanical properties and fatigue-strength behavior of silicon-carbide-whisker reinforced aluminum-alloy-matrix composites were examined at room temperature and 423 K and compared with wrought aluminum alloy. By this, the strengthening effects of SiC whisker, including the influence of whisker orientation and aspect ratio in aluminum alloy matrix composites were clarified. The results are as follows: (1) The Young's modulus of SiCw/A6061 composites are relatively isotropic and independent of whisker orientation and aspect ratio. (2) The static strength of SiCw/A6061 composites is dependent on matrix mechanical properties and whisker aspect ratio. (3) the fatigue strength of SiCw/A6061 composites is higher than matrix aluminum alloy. It is estimated that the fatigue behavior of composites results from its high resistance to crack initiation and crack propagation.

8403 **(PB—89-850382/XAB) Plastics and elastomers: electron-beam irradiation effects. January 1977-October 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1977-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 171p. NTIS PC N01/MF N01.

Supersedes PB—87-868808.

This bibliography contains citations concerning the effects that electron-beam irradiation has on polymers. Block copolymer stabilization, mechanical properties of radiation-crosslinked polymers, graft polymerization, electrical conductivity of radiated polymers, and apparatus utilization are among the topics discussed. The effects of curing in such areas as lithography, adhesives, protective coatings, and cable insulation are also included. (This updated bibliography contains 334 citations, 14 of which are new entries to the previous edition.)

8404 **(PB—89-850747/XAB) Radiation-curable polymer coatings. January 1970-October 1988 (Citations from the US Patent data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 82p. NTIS PC N01/MF N01.

Supersedes PB—88-853858.

This bibliography contains citations of selected patents concerning methods and compositions used in radiation curable polymer coatings. Protective and decorative coatings on metallic and nonmetallic substrates curable with light, including ultraviolet, are disclosed. Abrasion-resistant coating techniques are presented. (This updated bibliography contains 170 citations, 11 of which are new entries to the previous edition.)

8405 **(SAND—88-1242C) A structural investigation of compositionally graded InAs/sub x/Sb/sub 1-x/ buffer layers.** Biefeld, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-881061—8). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002890/JAW.

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The preparation of high quality InAs/sub x/Sb/sub 1-x// InSb strained-layer superlattices (SLS's) which absorb in the 8--12 μm range was achieved through the use of compositionally graded buffer layers grown by MOCVD. Comparisons of surface morphology and the residual strain determined by double crystal x-ray diffraction were made between four types of graded buffer layers. Both the buffer layer thickness and composition profile were found to affect the formation of microcracks and dislocations. The relaxation in these buffers is less than expected from equilibrium models, but it is more complete in the continuously graded than in the step-graded layers. Residual strain in the InAs/sub x/Sb/sub 1-x//InSb SLS's was minimized by preparing InAs/sub y/Sb/sub 1-y/ buffer layers in which the parallel lattice constant of the strained buffer layer was closely matched to the parallel lattice constant of the SLS. 21 refs., 3 figs., 1 tab.

8406 **(UCRL—96101) Organic nonlinear crystals and high power frequency conversion.** Velsko, S.P.; Davis, L.; Wang, F.; Monaco, S.; Eimerl, D. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 13p. (CONF-8708110—39). NTIS, PC A03/MF A01 - OSTI. Order Number DE89001921/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

We are searching for new second and third harmonic generators among the salts of organic acids and bases. We discuss the relevant properties of crystals from this group of compounds, including their nonlinear and phasematching characteristics, linear absorption, damage threshold and crystal growth. In addition, we

summarize what is known concerning other nonlinear optical properties of these crystals, such as two-photon absorption, nonlinear refractive index, and stimulated Raman thresholds. A preliminary assessment is made of the potential of these materials for use in future high power, large aperture lasers such as those used for inertial confinement fusion experiments. 16 refs., 3 tabs.

8407 (VTT-SYMP—87, pp 134-145) **Investigation of the corrosion resistance of different composed cemented waste forms.** Vejmelka, P.; Rudolph, G.; Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755690/JAW. (CONF-8709383—).

From 3. Finnish-German seminar on nuclear waste management; Espoo, Finland (23 Sep 1987).

According to the conceptual design of the Federal Republic of Germany 350 mtU reprocessing plant for LWR fuel, cementation will be employed for the solidification of evaporator concentrates, insoluble dissolution residues, cladding hulls and solid wastes. In the FRG the disposal of radioactive waste forms will be performed in rock salt formations. Consequently corrosion experiments with cement products of varying composition in quinary brine were performed to clarify the corrosion mechanism and investigate the dependence of the corrosion resistance from the sample composition. Quinary brine was selected as the corrosion medium from different solutions possibly occuring in salt formations because its high magnesium and sulfate content makes it most corrosive against cement products. The parameter studied in the corrosion experiments were cement type, w/c-ratio, hydration duration, salt content, additives and temperature. For the characterization of the samples prior to ageing in brine in addition to the compressive strength the specimen porosity was determined by mercury intrusion porosimetry and phase determination was performed by X-ray diffraction measurements. The corrosion progress was determined by measuring mechanical properties of the specimen (weight, compressive strength, tensile strength, dyn. E-modulus) and by performing X-ray measurements, microprobe analysis and chemical analysis of the leachant. In one serie the corrosion resistance of specimens of varying composition at 90 deg C was determined by measuring the lifetime of the specimen under the experimental conditions. The lifetime period was determined on the basis of the measurements of dynamic Elasticity-Modulus at the specimen's weight.

8408 **Annealing of GaAs single crystal: Relationship between electrical properties and structural defects.** Lee, B.; Bourret, E.D.; Gronsky, R.; Park, I. (Center for Advanced Materials, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Journal of Applied Physics;* **65**: No. 3, 1030-1035(1 Feb 1989).

The behavior of As-related structural defects (dislocation loops and As precipitates) and the changes in EL2 concentration during bulk annealing of an As-rich GaAs crystal were studied in the temperature range of 500—900 °C. Results show that the EL2 concentration increases and that some structural defects dissolve during bulk annealing above 600 °C, indicating that the source of point defects necessary to form EL2 during bulk annealing is the excess As condensed during crystal growth in various forms. It was observed that the excess As condenses as point defects, dislocation loops, and/or As precipitates, depending upon the cooling rate from high temperatures and availability of nucleation sites (dislocations). It was also determined that the solvus temperature for the crystal studied, with an excess As concentration of about $10^{16}/cm^3$, lies between 600 and 700 °C.

8409 **Characterization of InP/GaAs/Si structures grown by atmospheric pressure metalorganic chemical vapor deposition.** Pearton, S.J.; Short, K.T.; Macrander, A.T.; Abernathy, C.R.; Mazzi, V.P.; Haegel, N.M.; Al-Jassim, M.M.; Vernon, S.M.; Haven, V.E. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Applied Physics;* **65**: No. 3, 1083-1088(1 Feb 1989).

The thickness dependence of material quality of InP-GaAs-Si structures grown by atmospheric pressure metalorganic chemical vapor deposition was investigated. The InP thickness was varied from 1—4 μm, and that of the GaAs from 0.1—4 μm. For a given thickness of InP, its ion channeling yield and x-ray peak width were essentially independent of the GaAs layer thickness. The InP x-ray peak widths were typically 400—440 arcsec for 4-μm-thick layers grown on GaAs. The GaAs x-ray widths in turn varied from 320—1000 arcsec for layer thicknesses from 0.1—4 μm. Cross-sectional transmission electron microscopy showed high defect densities at both the InP-GaAs and GaAs-Si interfaces. In 4-μm-thick InP layers the average threading dislocation density was in the range (3—8) x $10^8$ $cm^{-2}$ with a stacking fault density within the range (0.4—2) x $10^8$ $cm^2$. The $He^+$ ion channeling yield near the InP surface was similar to that of bulk InP (chi/sub min/~4%), but rose rapidly toward the InP-GaAs heterointerface where it was typically around 50% for 1-μm-thick InP layers. All samples showed room-temperature luminescence, while at 4.4 K, exciton-related transitions, whose intensity was a function of the InP thickness, were observed.

8410 **Photothermal ionization spectroscopy of donors in high-purity germanium.** Darken, L.S. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6056). *Journal of Applied Physics;* **65**: No. 3, 1118-1125(1 Feb 1989).

The results of narrow linewidth (0.10 $cm^{-1}$ FWHM) photothermal ionization spectroscopy (PTIS) investigations of shallow donors in high-purity germanium are reported. The donors observed include phosphorus, arsenic, lithium, a hydrogen-oxygen complex, and three lithium-related complexes. One lithium-related complex designated D(Li,Y) is reported here for the first time. Within experimental accuracy, energies of the excited states with respect to the conduction band are the same for all donors. Fourteen different 1S→excited state transitions (five previously unreported, two others seen for the first time in PTIS from the ground state) have been observed. The Zeeman effect was used to help identify these levels. PTIS lines from the ground state to $2P_0$ and $3P_0$ were found to be relatively weak but their intensity was in good agreement with the intensity calculated by means of the Cascade theory. In as-grown samples, linewidth broadening of group V donors was observed that depended on the square root of the dislocation density (etch pit density) and with features expected from deformation potential theory.

8411 **X-ray photoelectron spectroscopy of ammonium sulfide treated GaAs (100) surfaces.** Cowans, B.A.; Dardas, Z.; Delgass, W.N.; Carpenter, M.S.; Melloch, M.R. (School of Chemical Engineering, Purdue University, West Lafayette, Indiana 47907). *Applied Physics Letters;* **54**: No. 4, 365-367(23 Jan 1989).

The effect of an ammonium sulfide treatment on the GaAs (100) surface has been investigated by x-ray photoelectron spectroscopy. The treatment produces a slight Ga enrichment on the surface and leaves roughly 0.6 of a monolayer of sulfide which inhibits initial oxidation of the surface. The sulfide is not lost as the surface becomes oxidized but appears to remain near the GaAs/oxide interface. Furthermore, in the oxidized layer, As oxide is preferentially drawn to the surface relative to Ga oxide.

8412 **Interaction of MeV ions with pre-existing damage in Si: A new ion beam annealing mechanism.** Holland, O.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Applied Physics Letters;* **54**: No. 4, 320-322(23 Jan 1989).

A new ion beam annealing phenomenon which occurs during room-temperature irradiation of Si is discussed. The interaction of high-energy ions with different damage morphologies is shown to depend on the detailed nature of the damage. This interaction leads to annealing when the damage consists only of simple types of defects, while irradiation of more complex damage morphologies can result in additional damage growth. A model is proposed which qualitatively accounts for the phenomenon.

8413 **Growth and characterization of (111) oriented GaInAs/GaAs strained-layer superlattices.** Beery, J.G.; Laurich, B.K.; Maggiore, C.J.; Smith, D.L.; Elcess, K.; Fonstad, C.G.; Mailhiot, C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **54**: No. 3, 233-235(16 Jan 1989).

We describe the growth, ion beam, and photoluminescence characterization of Ga/sub 1-//sub x/In/sub x/As/GaAs strained-layer superlattices grown along the [111] axis. The layer thicknesses and composition are determined by Rutherford backscattering. Normal incidence channeling gives a minimum channeling yield of 5.7%. Strain conditions are found by off-normal incidence channeling using the angular scan method. Comparison of the photoluminescence spectrum of the superlattice with theoretical calculations provides strong evidence for the existence of strain-generated electric fields in [111] growth axis strained-layer superlattices.

8414 **Band offsets for pseudomorphic InP/GaAs.** Nolte, D.D. (Center for Advanced Materials, Lawrence Berkeley Laboratory, and University of California, Berkeley, California 92720). *Applied Physics Letters;* **54**: No. 3, 259-261(16 Jan 1989).

Recently determined band-edge hydrostatic deformation potentials are used to predict heterojunction band offsets for the pseudomorphic GaAs-InP system. The calculations include GaAs/InP, InP/GaAs, and strained-layer GaAs-InP superlattices for both [100] and [111] oriented epitaxial growth. The offsets are type II for the unstrained case. The large hydrostatic contributions to the stress-induced band offsets can convert the offsets to type I. This conversion is especially apparent for growth in the [111] direction because of the small Poisson ratio for biaxial stress in the (111) plane.

8415 **Application of nuclear magnetic resonance pore structure analysis to porous silica glass.** D'Orazio, F.; Tarczon, J.; Halperin, W.P.; Eguchi, K.; Mizusaki, T. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208). *Journal of Applied Physics;* **65**: No. 2, 742-751(15 Jan 1989).

The internal pore structure of a series of porous silica glasses has been investigated using nuclear magnetic resonance (NMR). Longitudinal and transverse relaxation of protons in deionized water confined to the pores of the samples has been measured and interpreted to provide pore size distributions. Two sets of leached, phase-separated porous glasses were used: the first nominally bimodal, the second with a more uniform pore space with pore sizes varying from 32 to 1350 A. Our results provide a stringent test of NMR relaxation as a method for pore size analysis. NMR relaxation experiments were performed on one sample as a function of the amount of water imbibed confirming the validity of the theoretical model used to interpret the magnetic resonance data.

8416 **Phase formation and identification of an epitaxial Fe-Ni alloy silicide.** Chang, Y.S.; Hsieh, I.J.; Chen, H. (Department of Materials Science and Engineering, National Tsing-Hua University, Hsinchu, Taiwan, Republic of China). *Journal of Applied Physics;* **65**: No. 1, 154-157(1 Jan 1989).

Epitaxial iron-nickel alloy silicide has been successfully grown on (111) Si for the first time using a new method of chemically electroless plating of Fe-Ni thin films on Si with subsequent annealing schemes. The deposited film was found to be amorphous by analytical scanning transmission electron microscopy. The alloy silicide phase formed during two-step vacuum annealing and was found to have an epitaxial relationship with the substrate Si. The composition of the eptaxial alloy silicide was identified by an energy dispersive analysis for x rays in the electron microscope. A small amount of nickel was found in the alloy silicide. The crystal structure of the silicide phase was analyzed to be that of an orthorhombic phase of $FeSi_2$. The orientation relationships of the silicide phase with respect to the substrate were identified to be (033-bar) (Fe,Ni)$Si_2$parallel(022-bar) Si, (055) (Fe,Ni)$Si_2$parallel(4-bar22) Si, and [100] (Fe,Ni)$Si_2$parallel[111] Si. Typical arrays of regular interfacial dislocations of edge type, 1000 A in spacing, were found throughout the epitaxial regions. The formation and some potential applications of the epitaxial Fe-Ni alloy silicide are discussed.

8417 **Pseudomorphic InGaAs/GaAs/AlGaAs mirrors for optical devices in the near-infrared 0.9—1.3 μm.** Gourley, P.L.; Dawson, L.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 1, 380-383(1 Jan 1989).

We propose using pseudomorphic multilayers of InGaAs, GaAs, and AlGaAs in optical mirrors for near-infrared devices including surface-emitting lasers, bistable optical devices, and optical modulators. We demonstrate the growth of a Fabry—Perot etalon by molecular-beam epitaxy and characterize it optically (reflectance, transmittance, photoluminescence) and structurally (scanning electron microscopy and dislocation imaging). We find the optical characteristics of the etalon as a whole and the individual quarter-wave layers indicate high structural quality for the mirrors. This is in spite of the fact that the lattice constant of the etalon structure is slightly relaxed from that of the GaAs substrate. These results indicate that pseudomorphic mirrors are useful candidates for integrated optical devices.

8418 **Ion-bombardment-enhanced etching of $LiNbO_3$ using damage profile tailoring.** Ashby, C.I.H.; Arnold, G.W.; Brannon, P.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 1, 93-97(1 Jan 1989).

The production of a tailored implant-damage profile by sequential implantation of ions at several different energies rather than at a single energy can increase the depth and improve the wall smoothness of features produced by ion-bombardment-enhanced etching of a solid. This has been demonstrated in the enhanced etching of $LiNbO_3$ by HF following $He^+$ implantation at several energies and fluences selected to produce a relatively flat damage depth profile. The use of lighter ions permits the etching of deeper features than is possible with heavier ions of the same energy. Buried microcracks are observed in heavily implanted Z-cut samples. Similar microcracks may play an important role in determining propagation losses in ion-implanted waveguides.

8419 **Quantitative Auger electron spectroscopy of TiSi/sub y/: Peak height, line-shape, and sputtering yield analyses.** Galuska, A.A.; Wallace, W.O. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 9-16(Jan 1989).

The Auger electron spectroscopy (AES) peak heights, sputtering yields, and line shapes of well-characterized TiSi/sub y/ films were examined. Analysis of AES peak-to-peak heights showed that the total correction factor (K/sub T/) used for quantification varied linearly by a factor of 10 as the mole fraction of Si (X/sub Si/) changes from 0 to 1. The K/sub T/ variation was attributed primarily to preferential sputtering although line-shape variations also had some effect. The line shapes of the derivative Si/sub L//sub V//sub V/ and Ti/sub L//sub V//sub V/ spectra were examined as a function of X/sub Si/. The Ti/sub L//sub V//sub V/ line shape did not change significantly with composition. However, the characteristic features (peak height, peak width, skewdness, etc.) of the Si/sub L//sub V//sub V/ line shape were shown to vary linearly with silicide composition. The average sputtering rates and yields of the titanium silicides were shown to vary by a factor of 2 as X/sub Si/ varies from 0 to 1. The average sputtering yields of the silicides varied linearly with composition while the sputtering rates did not. The use of peak height, line-shape, and sputtering yield calibration lines for quantitative concentration and depth determinations is discussed.

8420 **Thermal oxidation of gallium arsenide.** Monteiro, O.R.; Evans, J.W. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 49-54(Jan 1989).

Here we present some results of transmission electron microscopy and secondary ion mass spectroscopy of thermally oxidized gallium arsenide with different types of dopants. At temperatures below 400 °C an amorphous oxide is formed. Oxidation at

temperatures between 500 and 600 °C initially produces an epitaxial film of $\gamma$-$Ga_2O_3$. As the reaction proceeds, this film becomes polycrystalline and then transforms to $\beta$-$Ga_2O_3$. This film contains small crystallites of $As_2O_5$ and $As_2O_3$ in the case of the chromium doped samples, whereas only the former was detected in the case of silicon and tellurium doped samples. Elemental arsenic was always found at the interface between the oxide and GaAs. Chromium doped gallium also exhibited a slower oxidation kinetics than the other materials.

8421 **Miniband dispersion in GaAs/Al/sub x/Ga/sub 1-//sub x/As superlattices with wide wells and very thin barriers.** Peterson, M.W.; Turner, J.A.; Parsons, C.A.; Nozik, A.J.; Arent, D.J.; Van Hoof, C.; Borghs, G.; Houdre, R.; Morkoc, H. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **53**: No. 26, 2666-2668(26 Dec 1988).

Photoreflectance spectra have been used to characterize miniband formation in GaAs/ Al/sub x/ Ga/sub 1-//sub x/ As superlattices with wide wells (275—255 A) and withb arriers as thin as 17 A. Thirty-two optical transitions are resolved in the photoreflectance spectra of the 17 A barrier sample. These experimental transitions match all those theoretically predicted from the selection rule $\Delta n = 0$, including $\Gamma$- and Pi-type transitions arising from miniband dispersion; these results imply sample perfection. A sample with a 40 A barrier exhibits forbidden transitions with $\Delta n \neq 0$; these additional transitions, together with the narrow width of the minibands for 40 A barriers, create difficulty in resolving the miniband structure.

8422 **Properties of $p^+$ microcrystalline films of SiC:H deposited by conventional rf glow discharge.** Goldstein, B.; Dickson, C.R.; Campbell, I.H.; Fauchet, P.M. (Solarex Thin Film Division, 826 Newtown—Yardley Road, Newtown, Pennsylvania 18940). *Applied Physics Letters;* **53**: No. 26, 2672-2674(26 Dec 1988).

Using a conventional rf glow discharge, we have grown microcrystalline $p^+$ SiC:H films having conductivities 2—2 x $10^{-3}$ $(\Omega\ cm)^{-1}$ and activation energies 0.05—0.1 eV with carbon concentrations 0—6 at. %, respectively. Increasing the carbon content suppresses the microcrystallinity. The choice of substrate is crucial to initiating the immediate onset of microcrystalline growth in thin (~200—400 A) films.

8423 **Surface diffusion of CO on Ni(111) studied by diffraction of optical second-harmonic generation off a monolayer grating.** Zhu, X.D.; Rasing, T.; Shen, Y.R. (Department of Physics, University of California, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 25, 2883-2885(19 Dec 1988).

Diffraction of optical second-harmonic generation from a monolayer grating created by laser desorption of adsorbates can be used to study surface diffusion of molecules on substrates. Application of this novel technique to CO on Ni(111) yields a diffusion activation energy of 6.9 kcal/mol and a preexponential factor of ≃1.2 x 10/sup -5/ $cm^2$s/sup -1/.

8424 **Nonlinear effects in desorption of valine with fast incident molecular ions.** Salehpour, M.; Fishel, D.L.; Hunt, J.E. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12320-12328(15 Dec 1988).

Fast molecular ions as primary particles have been used to study secondary-ion desorption from organic layers. The secondary molecular-ion yield of the amino acid valine (molecular weight, 117) has been measured as a function of the velocity of primary atomic and molecular incident ions. The primary ions used were $C^+$, $O^+$, $Ar^+$, $C_2^+$, $O_2^+$ , $CO^+$, $CO_2^+$, $CH^+$, $CH_3^+$, $CF^+$, $CF_3^+$, $C_3F_5^+$, and $C_4F_7^+$ in the energy range 600 keV—3.7 MeV. The secondary molecular-ion yields, when compared to yields for atomic constituents, unambiguously show that collective effects exist in desorption with incident molecular ions. Results are discussed in the framework of enhancement in the electronic stopping power per atom for molecular ions due to the vicinage of the fast-moving charges in the material. The resulting high-yield enhancements, especially with the use of large incident ions such as $C_3F_5^+$ and $C_4F_7^+$, are very encouraging for the future of mass spectrometry of large organic molecules.

8425 **Stress dependence of dislocation glide activation energy in single-crystal silicon-germanium alloys up to 2.6 GPa.** Dodson, B.W.; Tsao, J.Y. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12383-12387(15 Dec 1988).

A new approach to the study of plastic flow in semiconductors is introduced. By analyzing relaxation of misfit strain in metastable strained-layer structures, the effects of resolved shear stress up to several GPa can be examined, at least an order of magnitude larger than is accessible using conventional loading techniques. This new approach is used to study stress-dependent dislocation dynamics in silicon-germanium crystals at resolved shear stresses as high as 2.6 GPa. The results are consistent with a conventional picture of dislocation dynamics which includes climb and glide processes, where the glide activation energy depends linearly on the applied stress.

8426 **Picosecond response of photoexcited GaAs in a uniform electric field by Monte Carlo dynamics.** Wysin, G.M.; Smith, D.L.; Redondo, A. (Los Alamos National Laboratory, The University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12514-12524(15 Dec 1988).

The transient electrical response of GaAs photoexcited by a subpicosecond pulse, in the presence of a uniform biasing electric field, has been studied with use of a Monte Carlo calculation. Noninteracting electron transport is considered, using the three-valley model for the conduction band. Scattering from acoustic, optical, and intervalley phonons is included. The valence-band dispersion relations and valence- to conduction-band momentum matrix elements needed to treat the optical absorption were obtained from a full-zone kxp calculation. The optical absorption has been given a realistic treatment by including an effective energy linewidth resulting from the combination of the Fourier transform of the driving pulse, electron-phonon scattering, and the effect of the applied electric field. The average electron velocity is found to overshoot its steady-state value only if the electric field is larger than a critical value which increases with the photon energy. For example, these calculations indicate that at 5.0 kV/cm overshoot occurs for a photon energy of 1.5 eV but not for 1.7 eV. Velocity overshoot is seen to occur when the steady-state average electron energy (for the given applied field) is larger than the average electron energy of the initial photoexcited distribution. The regime of applied field and photon energy necessary for overshoot is mapped out.

8427 **Extended x-ray-absorption and electron-energy-loss fine-structure studies of the local atomic structure of amorphous unhydrogenated and hydrogenated silicon carbide.** Kaloyeros, A.E.; Rizk, R.B.; Woodhouse, J.B. (Department of Physics, State University of New York at Albany, Albany, New York 12222). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 13099-13106(15 Dec 1988).

Extended x-ray-absorption (EXAFS) and electron-energy-loss fine-structure (EXELFS) measurements have been performed on amorphous unhydrogenated silicon carbide, a-SiC, and amorphous hydrogenated silicon carbide, a-SiC:H. Two hydrogenated samples with hydrogen concentrations corresponding, respectively, to H flows of 4 sccm (20% of argon flow) and 8 sccm (40% of argon flow) during the reactive sputtering process, were analyzed (sccm denotes standard cubic centimeters per minute at STP). It is found that short-range order (SRO), consisting of the same tetrahedrally coordinated units present in cubic crystalline c-SiC (zinc-blende structure), where a Si atom is surrounded by nearly four C atoms and vice versa, does exist in all the amorphous samples. This SRO, however, is detected only at a level of the first C and Si coordination shells in a-SiC and a-SiC:H. The structural disorder of the first Si and C coordination shells in all forms of amorphous SiC is somewhat greater than c-SiC, and it decreases appreciably as hydrogen is added. The a-SiC sample exhibits large Si and C coordination numbers, almost identical to c-SiC, a low atomic density,

and virtually the same Si-C bond length as c-SiC. These results indicate that a relatively small concentration of large voids exist in a highly disordered a-SiC matrix.

8428 **Local valence-band densities of states of Al/sub x/Ga/sub 1-//sub x/As.** Tsang, K.L.; Rowe, J.E.; Callcott, T.A.; Logan, R.A. (Department of Physics and Astronomy, University of Tennesee, Knoxville, Tennessee 37996-1200). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 13277-13281(15 Dec 1988).

Aluminum L/sub 2,3/ soft-x-ray emission (SXE) spectra measured for Al/sub x/Ga/sub 1-//sub x/As in the range $0<x<0.8$ show changes due to modifications of the s-like local density of states (DOS) as the Al concentration is varied from $x = 0.05$ to $x = 0.8$. Differences in SXE data and x-ray photoemission spectra with alloy composition are attributed to the difference between the local DOS measured by SXE spectroscopy and the global DOS measured by photoemission spectroscopy. These measurements show a nonlinear shift of the top of the valence band and slope change near $x = 0.4$ may be explained in part by the role of cation d orbitals and other hybridization effects which correlate with the direct-band-gap—indirect-band-gap transition.

8429 **Anomalous temperature dependence in the Raman spectra of l-alanine: Evidence for dynamic localization.** Migliori, A.; Maxton, P.M.; Clogston, A.M.; Zirngiebl, E.; Lowe, M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 18, 13464-13467(15 Dec 1988).

We measured the temperature dependence of the intensity of the two lowest Raman modes in single crystals of l-alanine. The sum of the intensities obeys Maxwell-Boltzman statistics accurately from 20 to 340 K but the intensities of the individual lines are anomalous. This behavior is explained by assuming that both lines share the same degrees of freedom but that a mode instability is triggered abruptly at an occupation of seven quanta. This instability, which has an activation energy of 500 K, is observed at temperatures as low as 20 K, possibly indicating the existence of dynamic localization of vibrational energy.

8430 **Observation of near-surface damage by phonon scattering.** Maboudian, R.; Carraro, C.; Goodstein, D.L.; Housley, R.M.; Tombrello, T.A. (Department of Condensed Matter Physics, California Institute of Technology, 114-36, Pasadena, California 91125). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12190-12199(15 Dec 1988).

We have investigated the feasibility of phonon-reflection techniques as nondestructive means to probe surface and/or near-surface damage in otherwise highly perfect crystals. An UHV liquid-helium stage, suitable for phonon-reflection measurements, was installed on a beam line of a tandem van de Graaff accelerator which was used to implant MeV ions into the substrate in order to modify the surface region in situ. Here, we report our investigation on the effects of 1-MeV $Ar^+$ implantation in $Al_2O_3$ single crystals by monitoring the reflection of terahertz (THz) phonons (50-A wavelength) from the implanted region. The results are compared to other surface techniques. Using a 15-kV ion gun on the same beam line, we have also bombarded $Al_2O_3$ crystals coated with thin films of gold. The effects of a 7.5-keV $Ar^+$ beam on this Au-$Al_2O_3$ system are also discussed in this paper.

8431 **Elastic properties of Si during amorphization.** Bhadra, R.; Pearson, J.; Okamoto, P.; Rehn, L.; Grimsditch, M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 17, 12656-12659(15 Dec 1988).

The behavior of shear moduli of Si have been studied during amorphization. The amorphization was achieved by irradiation with 1.8-MeV Kr ions and was monitored by means of transmission electron microscopy and Raman spectroscopy. The elastic properties were investigated using Brillouin scattering techniques. Unlike what has been observed in $Nb_3Ir$ and $Zr_3Al$, where the elastic constant changes dramatically, even before the sample becomes amorphous, the elastic constants of Si change only when the sample shows signs of becoming amorphous.

8432 **Bond-charge Coulomb repulsion in Peierls-Hubbard models.** Campbell, D.K.; Gammel, J.T.; Loh E.Y. Jr. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 12043-12046(1 Dec 1988).

We investigate the general applicability of the standard Peierls-Hubbard model, involving both on-site (U) and nearest-neighbor (V) Coulomb repulsions, by adding nearest-neighbor off-diagonal terms representing the bond (W) and mixed bond-site (X) electron-electron repulsive interactions. For a broad range of the site-diagonal Hubbard parameters (U,V), we find that the off-diagonal terms (W, X) initially enhance dimerization, thereby stabilizing the dimerized ground state.

8433 **Low-temperature magnetic structure of MnO: A high-resolution neutron-diffraction study.** Shaked, H.; Faber J. Jr.; Hitterman, R.L. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11901-11903(1 Dec 1988).

The antiferromagnetic structure of MnO was studied using high-resolution neutron diffraction from a polycrystalline sample at 8 K. The "allowed-reflection rule" which is obeyed by the observed reflections was deduced. By use of this rule, and without recourse to calculation of intensities, it is shown unambiguously that the magnetic structure is collinear, and the magnetic configuration is deduced. By using the (115)-to-(333) magnetic intensity ratio (whose splitting is observable only with high resolution), we found that within our experimental resolution, the spin axis is perpendicular to the unique [111] direction.

8434 **Method for producing solid or hollow spherical particles of chosen chemical composition and of uniform size.** Hendricks, C.D. (to Dept. of Energy, Washington, DC). US Patent 4,774,037. 27 Sep 1988. Filed date 26 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for producing hollow spherical particles is described consisting of a material, from a hollow rod that also consists of the material. The method includes the steps of: internally pressurizing the rod; introducing an end of the pressurized rod into a focused beam of laser light having sufficient power to melt the material at the end of the pressurized rod; and vibrating the end of the pressurized rod to produce hollow spherical particles from the melted material.

8435 **Superconductivity: As temperatures rise, so do demands on MEs.** Moon, F.; Hull, J.R.; Berry, G.F. (Sibley School of Mechanical and Aerospace Engineering, Cornell Univ., Ithaca, NY (US)). *Waste Age;* **110**: No. 6, 60-69(Jun 1988).

The discovery of materials that exhibit superconductivity at the temperature of liquid nitrogen has excited a great deal of research and speculation. Transforming these new superconductors into useful components will test the expertise of mechanical engineers in the areas of heat transfer, structural mechanics, and materials processing.

8436 **Update on progress toward a crystal streak camera using new materials.** Jelsma, L.F.; Steele, D.L. (Lawrence Livermore National Lab., Electronics Engineering Dept., P.O. Box 808, Livermore, CA (US)). pp 198-202 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

Several new materials have electrooptical coefficients that are high in comparison with that of lithium niobate (31 x 10/sup -12/ m/V). These new materials are Sr/sub chi/Ba/sub 1-chi/Nb/sub 2/O/sub 6/ (SBN:100chi); Sr/sub chi/Ba/sub 1-chi/K/sub 1-y/Na/sub y/Nb/sub 2/O/sub 6/ (BSKNN); and polymeric, ultrathin films. For SBN:60, SBN:75, and BSKNN, electrooptical coefficients of 400 x 10/sup -12/ m/V, 1400 x 10/sup -12/ m/V, and 150

x 10/sup -12/ m/V, respectively, have been reported. In this paper, the authors review the theory of light-steering machines and predict the theoretical performance of these systems using these new electrooptical materials. They include new, innovative methods for increasing the resolution of these systems. In addressing problems in fabricating the crystals, the authors discuss crystal properties that must be controlled if the development of a practical crystal streak camera is to be successful. Finally, they present experimental results from a laboratory-built light deflector using SBN:60.

8437 **Superconductivity and disorder in low carrier density La-S.** Kapitulnik, A.; Kent, A.D.; Geballe, T.H.; Kaufman, J.H. (Stanford Univ., CA (USA)). pp 61-72 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

La-S films near the metal-insulator transition were prepared and characterized. Localization and percolation effects were observed in the films and the interplay between them was studied.

8438 **Evidence for nonphononic superconductivity in $Nb_3Ge$.** Kihlstrom, K.E.; Hovda, P.D.; Kresin, V.Z.; Wolf, S.A. (Westmont College, Santa Barbara, CA (USA)). pp 95-101 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A quantitative test was performed to separate phononic from nonphononic contributions to the superconductivity in A15 $Nb_3Ge$. The method proposed by V. Z. Kresin has been used. This method is based on analysis of heat capacity and tunneling $\alpha$ $^2F$ (omega) data and neutron scattering data. Evidence was obtained that the superconductivity in $Nb_3Ge$ is substantially caused by a nonphononic mechanism. In contrast, the results suggest the superconducting state in Pb and $V_3Si$ is due to phonons.

8439 **One-Dimensional correlations in organic superconductors: magnetism and superconductivity.** Jerome, D.; Creuzet, F. (Universite Paris, Orsay (France)). pp 103-133 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The examination of far infrared optical conductivity and nuclear spin-lattice relaxation experiments performed in the conducting phase of $(TMTSF)_2X$ organic superconductors reveals strong deviations at low temperature to the Drude and Korringa behaviors of usual metallic conductors. These experimental data suggest the existence of divergent one dimensional 2k/sub F/ correlations in a large temperature domain extending down to about SK. They have also contributed to the development of a model for organic superconductivity which relies on the possibility of a non-phonon mediated Cooper pairing, boosted by an interchain exchange of spin fluctuations.

8440 **Anisotropic superconductivity and NMR relaxation rate in organic superconductors.** Hasegawa, Y.; Fukuyama, H. (Univ. of Tokyo (Japan)). pp 135-140 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Possible types of superconductivity in both quasi-one- and quasi-two-dimensional systems are examined theoretically. The NMR relaxation rate, $T_1^{-1}$, is calculated for each state. The comparison with the experiment in $(TMTSF)_2ClO_4$, which is the quasi-one-dimensional organic superconductor, indicates that the superconductivity of this family has lines of zeros of the gap on the Fermi surface. It is suggested that $\beta$-$(BEDT\text{-}TTF)_2X$ can be in the triplet state.

8441 **Nuclear magnetic relaxation in the organic superconductor $(TMTSF)_2ClO_4$.** Takigawa, M.; Yasuoka, H.; Saito, G.; Maniwa, Y.; Takahashi, T. (Univ. of Tokyo (Japan)). pp 141-148 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

$(TMTSF)_2ClO_4$ has a unique property that different low temperature states are obtained depending upon the cooling speed of a sample around the structural phase transition temperature (24K) at which the orientational order of tetrahedral $ClO_4$ anions takes place. So far, no microscopic experiment has been done that is directly concerned with the elementary excitation in the superconducting state such as ultrasonic attenuation or nuclear relaxation rate. The results of proton NMR relation rate $(1/T_1)$ in $(TMTSF)_2ClO_4$ with the emphasis on its temperature dependence in the superconducting state are presented.

8442 **Synthesis, structure and properties of BEDT-TTF derivatives.** Nigrey, P.J.; Morosin, B.; Kwak, J.F. (Sandia National Labs., Albuquerque, NM (USA)). pp 171-179 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC04-76DP00789.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

In summary, the authors have shown that the organometallic reagent (1) can be used as a synthetic reagent in the preparation of the partially selenium substituted BADSe-TTF donors. This generalized procedure was exemplified by the synthesis of BMDSe-TTF which was obtained in an overall yield of 36%. Since the structure of (1) was found to be isostructural with that of the all sulfur nickel complex, in whose TTF C-T salt three dimensional superconductivity was thought to occur, it may be possible to utilize (1) for the synthesis of similar materials. They have also presented data on the pressure dependence of conductivity in $(BMDT\text{-}TTF)_2Au(CN)_2$ for which they find that modest pressures cause the retention of the metallic state to low temperatures. Through the appropriate choice of donor/anion combinations, it may be possible to stabilize the metallic state in this material and induce superconductivity in this class of materials.

8443 **Possibility of high-temperature superconductivity in organic materials.** Ladik, J.J.; Collins, T.C. (Alexander-University Erlangen-Nuernberg (West Germany)). pp 181-185 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

First the different models of excitonic superconductivity in 2D and quasi 1D systems are shortly reviewed. Afterwards the possibility of superconductivity in the TCNQ molecular crystal, which has a narrow valence band and a broad conduction band is discussed. As next step the possibility of making the layers in graphite superconducting through doping will be mentioned. Subsequently a theoretical model (based first of all on the localization of the wave functions on the highly polarizable Y, La etc. atoms) for high T/sub c/ superconductivity in $Ba_2YCu_3O_7$ systems will be presented. Finally, the necessary quantum mechanical calculations to prove this theory will be outlined.

8444 **The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films.** Budd, K.D.; Dey, S.K.; Payne, D.A. (Dept. of Ceramic Engineering and Materials Research Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). pp 317-322 of Electronic packaging materials science II. Jackson, K.A.; Pohanka, R.C.; Uhlmann, D.R.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Sol-gel processing represents a promising method of fabrication for thin films of electronic ceramics which are useful in a number of packaging and device applications. In this study, the in-

fluence of acid and base catalysts on the structure of PbTiO/sub 3/ gels and films (0.1-1.0 μm) was investigated, for the purpose of inducing and identifying gel structures which were the most suitable as precursors for thin dielectric layers. Continuous, crack-free films, with dielectric strengths in excess of 10/sup 6/ V/cm were developed. Basic solutions gelled rapidly, phase separated, and were probably more crosslinked than acidic gels. Acidic gels seemed more capable of polymeric rearrangement during drying, yielding denser amorphous structures with microcrystalline regions. High-field dielectric constants (1 MV/m ac) in the range K=30-40, and K=160,170, were determined for amorphous and crystalline films, respectively.

8445 **Properties of E-beam interactive oxide films.** Hollenbeck, J.L.; Buchanan, R.C. (Dept. of Ceramic Engineering, Univ. of Illinois (US)). pp 289-296 of Electronic packaging materials science II. Jackson, K.A.; Pohanka, R.C.; Uhlmann, D.R.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Deposition of E-beam interactive films by rf sputtering and their behavior under high intensity irradiation was investigated. Both polycrystalline and amorphous films of SiO/sub 2/, ZrP/sub 2/, Al/sub 2/O/sub 3/, and Y/sub 2/O/sub 3/ were deposited and their behavior under irradiation found to be strongly dependent on film structure. Using a modified STEM the formation of small holes (<10nm diam.) was achieved with exposure times in the millisecond range. Deposition parameters, film characteristics, drilling behavior, and a possible mechanism are discussed.

8446 **Microstructural observations and mechanical behavior of Pb-Sn solder on copper plates.** Frear, D.; Grivas, D.; Quan, L.; Morris, J.W. Jr. (Center for Advanced Materials, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 181-186 of Electronic packaging materials science II. Jackson, K.A.; Pohanka, R.C.; Uhlmann, D.R.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The microstructure and mechanical properties of Pb-Sn solder joining Cu plates were studied. Microstructural observations were made on both the bulk Pb-Sn solder and on the interface between the solder and Cu plates. Pb-Sn solder has a two-phase microstructure in which the Pb-rich phase is the weaker. B-Sn precipitates in the Pb-rich phase were characterized in TEM. Intermetallic phases (Cu/sub 6/Sn/sub 5/ and Cu/sub 3/Sn) that form during the reaction of molten Pb-Sn solder with Cu were investigated. Solder joints were tested to fracture in both shear and tensile configurations. The mechanical properties and fracture surface characteristics are reported.

8447 **Microstructural and chemical components of ceramic-metal interfacial fracture energies.** Cannon, R.M.; Jayaram, V.; Dalgleish, B.J.; Fisher, R.M. (Center for Advanced Materials, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 121-126 of Electronic packaging materials science II. Jackson, K.A.; Pohanka, R.C.; Uhlmann, D.R.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Failure of ceramic-metal interfaces induced by residual or applied stress is often brittle in nature although plastic strain in one or more bonding layers may add to the fracture energy for decohesion. Thus, the fracture toughness depends on chemical bonding across the interface, the plasticity and flow stress of the metal as well as other factors, arising from local internal stresses and the microstructure of the ceramic-metal couple, that cause crack tip branching, deflection, bridging, blunting or shielding. Electron microscopy and DCB testing of metal-glass systems provide insights into the relative importance of factors that determine the decohesion resistance.

8448 **Glass films and interfaces in microelectronic applications.** Buchanan, R.C.; Beck, C.V. (Dept. of Ceramic Engineering, Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). pp 41-46 of Electronic packaging materials science II. Jackson, K.A.; Pohanka, R.C.; Uhlmann, D.R.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Use of dielectric films is integral to most microelectronic packaging, as passive components for device insulation (interlayer dielectric, passivation, diffusion layer), as thin layer capacitive structures or as insulating coatings for thin film and thick film hybrid circuits. Depending on deposition technique, film composition may include SiO/sub 2/, Al/sub 2/O/sub 3/, Si/sub 3/N/sub 4/, modified silicate or phosphate glasses as insulators. Compositions as well as methodologies for film preparation on Si, glass or metal substrate by spin coating (or spraying) are discussed, including film/substrate interface characteristics and properties related to dielectric film coatings.

8449 **Layered structures, epitaxy, and interfaces.** Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). 649p. (CONF-841157—). Materials Research Society, 9800 Mc Knight Rd., Suite 327, Pittsburgh, PA 15237.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

This book contains papers presented at a symposium on layered structures - epitaxy and interfaces. Topics include the following: processing; mechanical properties and reliability; interface and films; polymers; microstructural and chemical compounds of ceramic metals interfacial fracture energies.

8450 **Terracing in strained-layer superlattices.** Neumann, D.A.; Zabel, H.; Morkoc, H. (Dept. of Physics and Materials Research Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)). pp 47-52 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The authors report an x-ray diffraction study of GaAs/GaAs/sub 1-x/Sb/sub x/ superlattices which shows superlattice reflections that do not lie on a reciprocal lattice rod of the substrate. This result is attributed to a terraced structure which imposes a tilt on the entire film with respect to the substrate. This effect and a transverse broadening of the superlattice peaks are described by a model which approximates the strain at the interfacial steps.

8451 **Surface characterization of arsenic implanted silicon (100): A new insight into the inhibition of aluminum/silicon interdiffusion.** Herbots, N.; Gloesener, D.; Van Loenen, E.J.; Fischer, A.E.M.J. (Solid State Div., Oak Ridge National Lab. (US)). pp 613-618 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Arsenic segregation at Si(100) surfaces during annealing (890-970°C) has been studied by medium energy ion scattering (MEIS), Rutherford backscattering spectrometry (RBS), ion scattering spectrometry (ISS), and Auger electron spectroscopy (AES). The unique depth resolution of MEIS revealed that arsenic segregated in a two-dimensional layer at the clean Si surface during annealing. For a surface with a native oxide the arsenic piled up at the Si/oxide interface. This segregation peak was no longer present on the Si surface after conventional contact opening. By metallizing arsenic junctions with Al:Si, 1% it was found that a segregation annealing step inhibited Al/Si interdiffusion. Diodes as shallow as 180 nm could be metallized within spiking.

**8452 Pd/sub 2/Si on Si(111) growth kinetics studied by x-ray diffraction.** Coulman, B.; Chen, H. (Philips Research Lab., Sunnyvale, Signetics Corp., Sunnyvale, CA (US)). pp 601-606 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Results are presented for the kinetics of growth of Pd/sub 2/Si interfacial layers obtained by an X-ray diffraction technique. Epitaxial Pd/sub 2/Si films were grown on Si(111) substrates over a temperature range of 160 - 122°C. The parabolic rate law observed is in qualitative agreement with those reported by investigators using other techniques (RBS, AES, Electron Microprobe). There appear to be two kinetic regimes distinguished by diffusion paths with different activation energies (1.35 +- 0.10 eV vs. 1.05 +- 0.10 eV). The presence of impurities and the detailed Pd/sub 2/Si microstructure will influence how the reacting species are transported through the lattice.

**8453 A review of recent results on single crystal metastable semiconductors: Crystal growth, phase stability, and physical properties.** Barnett, S.A.; Kramer, B.; Romano, L.T.; Shah, S.I.; Ray, M.A.; Fang, S.; Greene, J.E. (Dept. of Metallurgy, the Coordinated Science, Lab., and the Materials Research Lab., Univ. of Illinois, Urbana, IL (US)). pp 285-294 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Recent results on metastable semiconducting allows, concerning in particular the growth of new Sn-based alloys (GaSb)/sub 1-chi/(Sn/sub 2/)/sub chi/ and Ge/sub 1-x/Sn/sub x/ and the physical properties of (GaAs)/sub 1-chi/(Ge/sub 2/)/sub chi/ and (GaSb)/sub 1-chi/(Ge/sub 2/)/sub x/, are discussed. (GaSb)/sub 1-x/(Sn/sub 2/)/sub x/ and Ge/sub 1-chi/Sn/sub chi/ alloy films were grown with chi-values as high as 0.20 and 0.15, respectively, well in excess of equilibrium Sn solid solubility limits (≦ 1%) while epitaxial (GaAs)/sub 1-x/(Ge/sub 2/)/sub x/ and (GaSb)/sub 1-x/(Ge/sub 2/)/sub x/ alloys were obtained on (100) GaAs at compositions ranging across the psuedobinary phase diagram. Low energy ion bombardment induced collisional mixing and preferential sputtering during film growth played a critical role in obtaining single phase alloys. An optimal ion energy, which depended on the ion flux and the alloy composition, was determined, allowing in most cases growth at temperatures T/sub s/ sufficient for obtaining single crystal alloys on (100)GaAs and (100) Ge substrates. Decomposition of the Sn-based alloys occurred above a critical T/sub S/-value via α-Sn-rich precipitates which were stable above the B-Sn melting point. X-ray diffraction, STEM, EXAFS, and Raman spectroscopy measurements, performed on single crystal (GaAs)/sub 1-chi/(Ge/sub 2/)/sub chi/ and (GaSb)/sub 1-chi/(Ge/sub 2/)/sub chi/ alloys, indicate that there is a transition in the long-range order from zincblende to diamond with increasing chi while the short-range orders remains perfect at all compositions, i.e. no V-v or III-III bonds are observed. These results are discussed in light of recent models which relate (GaAs)/sub 1-chi/(Ge/sub 2/)/sub chi/ atomic structure to its band structure and optical properties.

**8454 The characterization of thin films and layered structures using x-ray absorption and reflection at grazing incidence.** Heald, S.M.; Tranquada, J.M.; Welch, D.O.; Chen, H. (Metallurgy and Materials Science Div., Brookhaven National Lab., Upton, NY (US)). pp 437-442 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

X-rays at grazing incidence have a short, controllable penetration depth and are well suited as a probe of surface and interface structures. This paper examines the possibility of applying grazing-incidence reflectivity and Extended X-ray Absorption Fine Structure (EXAFS) measurements to such systems. Results are presented for an Al-Cu couple for which both high resolution reflectivity and interface EXAFS measurements are made. The latter results are the first interface specific EXAFS data to be reported. Distinct changes in both signals are observed upon annealing, demonstrating the potential of the techniques.

**8455 Metastability of a perfect SLS interface.** Dodson, B.W. (Div. 1131, Sandia National Labs., Albuquerque, NM (US)). pp 327-330 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

In the context of a model system whose atoms interact via Lennard-Jones (LJ) interatomic potentials, the authors studied the stability of an initially perfect strained layer superlattice (SLS) and the process of growth of a mismatched layer on a substrate using Monte Carlo techniques. An initially perfect SLS interface is found to be metastable up to 12% mismatch, a much higher value than is found on real SLS systems. In contrast, they find that, within the limitations of the calculations, a perfect SLS interface cannot be grown in an LJ system. The implications of these results for understanding SLS growth processes is discussed.

**8456 An evaluation of implantation-disordering of (InGa)As/GaAs strained-layer superlattices.** Myers, D.R.; Barnes, C.E.; Arnold, G.W.; Dawson, L.R.; Biefeld, R.M.; Zipperian, T.E.; Gourley, P.L.; Fritz, I.J. (Sandia National Labs., Albuquerque, NM (US)). pp 313-318 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The authors examined the optical and transport properties of In/sub .2/Ga/sub .8/As/GaAs strained-layer superlattices (SLS's) which have been implanted either with 5 x 10/sup 15//cm/sup 2/, 250keV Zn/sup +/ or with 5 x 10/sup 14//cm/sup 2/, 70KeV Be/sup +/ and annealed under an arsenic overpressure at 600°C. For both cases, electrical activation in the implantation-doped regions equalled that of similar implants and anneals in bulk GaAs, even though the Be implant retained the SLS structure, while the Zn implant intermixed the SLS layers to produce an alloy semiconductor of the average SLS composition. Photoluminescence intensities in the annealed implanted regions are significantly reduced from that of virgin material, apparently due to residual implant damage. Diodes formed from both the Be- and the Zn-implanted SLS's produced electroluminescence intensity comparable to that of grown-junction SLS diodes in the same chemical system, despite the implantation processing and potential for vertical lattice mismatch in the Zn-disordered SLS device. These results indicate that Zn-disordering can be as useful in strained-layer superlattices as in lattice-matched systems.

**8457 Ion implantation disorder in strained-layer superlattices.** Arnold, G.W.; Picraux, S.T.; Peercy, P.S.; Myers, D.R.; Biefeld, R.M.; Dawson, L.R. (Sandia National Labs., Albuquerque, NM (US)). pp 307-312 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Cantilever-beam bending and RBS channeling measurements have been used to examine implantation-induced disorder and stress buildup in In/sub 0.2/Ga/sub 0.8/As/GaAs SLS structures. Implantation fluences from 10/sup 11/ to 10/sup 15//cm/sup 2/ were used for 150 keV Si, 320 keV Kr, and 250 keV Zn in SLS and GaAs bulk materials. The critical fluence for saturation of compressive stress occurs prior to amorphous layer formation and is followed by stress relief. For all the ions the maximum ion induced stress scales with energy density into atomic processes an stress relief occurs above — 1 x 10/sup 20/ keV/cm/sup 3/. Stress relief is more pronounced for the SLSs than for bulk GaAs. The authors suggest that stress-relief may lead to slip or other forms of inelastic material flow in SLSs, which would be undesirable for active regions in device applications. Such material flow may be avoided by

limiting maximum fluences or by multiple-step implantation and annealing cycles (or hot implants) at high fluences.

8458 **Strained-layer superlattices and strain-induced light holes.** Osbourn, G.C. (Sandia National Labs., Albuquerque, NM (US)). pp 219-222 of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The capability of growing high quality strained-layer superlattices (SLS's) from lattice-mismatched semiconductors opens up new opportunities in both basic and applied material sciences. This flexibility in the choice of SLS layer materials allows the study of quantum well effects in a variety of new and interesting heterojunction systems. In addition, the large tetragonal distortions of the SLS layers allow these structures to exhibit unique features which are not found in bulk semiconductors. An exciting example is the possibility of tailoring certain SLS materials so that they exhibit small two dimensional hole effective masses and enhanced low field hole mobilities at low temperatures and low carrier concentrations. Band structure calculations indicate that the layer strains, the direct band gap magnitudes of the layers, the valence and band offset, and the hole energies all can play a role in determining these small two dimensional hole effective mass values.

# 40 CHEMISTRY

## 4001 Analytical And Separations Chemistry

*REFER ALSO TO CITATION(S) 7227, 7248, 7393, 7405, 8030, 8128, 8728, 9297, 9325, 9381, 9809, 9810, 10134, 10135, 10547*

8459 **(AD-A—197289/2/XAB) Mass spectral investigations on toxins. 9. Application of liquid chromatography/mass spectrometry techniques for the detection and quantification of macrocyclic trichothecenes in Brazilian plant samples. Technical report, March-July 1985.** Krishnamurthy, T.; Beck, D.J.; Isensee, R.K.; Jarvis, B.B. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Apr 1988. 25p. (CRDEC-TR—88074). NTIS, PC A03/MF A01.

See also AD-A175 457.

Trichothecenes are toxic, fungal metabolites that have been associated with human health hazards, farm-product, livestock, and other animal losses for decades. Allegedly, these metabolites were also used as chemical warfare agents. Recently, the growth of trichothecene-producing fungi was detected also in U.S. urban environments. Thus, the development of rapid, specific, sensitive, and accurate methods for analyzing these toxins in environmental, agricultural, and biological samples has become vital. The large number of trichothecenes present and their polar and labile properties pose a great challenge in developing a common methodology to analyze all the derivatives of interest. Thermally labile, polar, toxic roridins and biologically active baccharinoids were separated over a reverse phase, high-performance liquid-chromatographic column and effectively ionized under thermospray ionization conditions. The mass spectra indicated the formation of corresponding molecular ion-ammonium adducts in great abundance. Experiments designed for monitoring specific ions of these analytes at predesignated intervals were used to accurately analyze these macrocyclic trichothecenes in real, crude samples. A synthetically modified macrocyclic trichothecene, 8-ketoverrucarin A, was used as the internal standard for detecting and quantifying these compounds. The minimum detectable limits were from 1 to 2 nanograms.

8460 **(AD-A—197709/9/XAB) Characterization of the microwave-induced plasma as a detector for supercritical fluid chromatography. Technical report.** Galante, L.J.; Selby, M.; Luffer, D.R.; Hieftje, G.M.; Novotny, M. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 11 Jul 1988. 42p. (INDU/DC/GMH/TR—88-30). NTIS, PC A03/MF A01.

A microwave-induced plasma (MIP) sustained in helium is evaluated as an element-selective detector for capillary supercritical fluid chromatography (SFC). The plasma source, a surface microwave-induced plasma (surfatron), is described. Optimal plasma conditions including viewing position, helium flow rate, and applied microwave power are discussed for sulfur emission in the near-infrared spectral region. In addition, the effects of two common mobile phases ($CO_2$ and $N_2O$) on plasma stability, sensitivity, and spectral background from 200 nm to 1100 nm are assessed. Although the plasma was evaluated principally for use with SFC, much of the discussion is relevant to its application as a gas-chromatographic detector.

8461 **(AD-A—198302/2/XAB) Technology assessment of field portable instrumentation for use at Rocky Mountain Arsenal. Final report, May 1987-March 1988.** Jenkins, R.A.; Maskarinec, M.P.; Griest, W.H.; Dyer, F.F.; Moody, R.L. (Oak Ridge National Lab., TN (USA)). 1 Jul 1988. 111p. (ORNL-TM—10542). NTIS, PC A06/MF A01.

An assessment was made of commercially available field instrumentation for analysis of samples at Rocky Mountain Arsenal. The analytes considered were metals, volatile organics, and semivolatile organics. Colorimetric tests for metals are recommended for screening, with positives being confirmed by microwave digestion followed by portable atomic absorption. A portable mercury monitor is recommended for this analysis. Portable X-ray fluorescence is recommended for higher levels of inorganics. For volatile organics, purge and trap and heated headspace followed by portable gas chromatography are recommended. For semivolatiles in soil, SOXTEC extraction and gas or thin-layer chromatography are recommended. For semivolatiles in water, solvent extraction using a MIXXOR is recommended.

8462 **(AD-A—198592/8/XAB) Future of intelligent spectrometers in metal speciation by atomic emission spectrometry. Technical report.** Denton, M.B.; Bilhorn, R.B. (Arizona Univ., Tucson (USA). Dept. of Chemistry). 4 Feb 1988. 4p. (TR—56). NTIS, PC A02/MF A01.

Powerful new analytical capabilities are becoming available as the result of coupling various separation techniques with modern atomic spectrometry. These approaches can provide the analyst with tremendous insight into the elemental composition of each eluding constituent. The very factors that allow atomic emission to provide element-specific detection for virtually the entire periodic table can cause major problems when trying to apply the technique to separation techniques such as gas and liquid chromatography. The resulting transient signals and background effects over a large-wavelength region, coupled with the relatively narrow atomic-line band width, present problems in both detection and data manipulation. These problems will be reviewed, and various potential solutions considered. A new approach that holds great promise for handling these problems is presented. This technique employs array detectors capable of simultaneously observing a very large number of wavelengths, providing analyztical, background, and diagnostic data. When used in conjunction with appropriate software, an entirely new dimension of intelligent instrument becomes possible. Operational capabilities of such instrumentation are presented, including data from a variety of chemical systems.

8463 **(AD-A—198727/0/XAB) Detection of negative ions by inductively coupled plasma mass spectrometry. Technical report.** Hieftje, G.M.; Vickers, G.H.; Wilson, D.A. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 11 Jul 1988. 26p. (INDU/DC/GMH/TR—88-29). NTIS, PC A03/MF A01.

The analytical utility of negative-ion detection is evaluated for the determination of nonmetals by inductively coupled plasma-mass spectrometry. The background spectrum is simpler than for positive ions, although the baseline background level is a factor of 50 times higher. The only elemental species that can be detected with reasonable sensitivity as negative ions are the halogens. For these ions, calibration curves are linear over at least four orders of magnitude and detection limits range from 10 to 400 ng/mL. Other characteristics that are evaluated include isotope ratios, matrix effects caused by the associated cation or the anion speciation, and polyatomic-ion formation.

8464 **(BARC—1403) Determination of trace level rhenium in copper fly ash: A.d.c. arc spectrographic method.** Kamat, M.J.; Kaimal, R.; Malhotra, S.K. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88704994/JAW.

A d.c. arc spectrographic method for the determination of trace amounts of Re in copper fly ash matrix has been developed. The samples and standards are mixed with Ga/sub 2/O/sub 3/, used as buffer in the ratio 1:1. A charge of 15 mg is loaded in UCC 1991 graphite electrode and is excited in 10A d.c. arc. The spectra are recorded for 30s on Kodak SA-1 emulsion, employing Hilger large quartz spectrograph. The range of concentration determined is 5-200 ppm and the average precision of the method in terms of coefficient of variation is +-10 per cent. (author). 4 tables, 8 refs.

8465 **(CBPF-NF—017/88) Use of "sunlamps" on the optical damping of the natural thermoluminescence of minerals. Consequences for geochronology by Tl.** Poupeau, G.; Rivera, A.; Soliani Junior, E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Geociencias). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 22p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705009/JAW.

It was studied the effect of exposure to "sunlamps" and direct and indirect sunlight on the 380/sup 0/C peak of 100-200 μm quartz grains (with a blue-violet filter), from various sands last naturally illuminated by sunlight some <or approx., 1700 yr ago to >or approx., 120.000 yr ago. (M.W.O.).

8466 **(CEA-CONF—9295) Nuclear microprobe analysis of carbon within glass inclusions and volcanic materials.** Metrich, N.; Mosbah, M.; Trocellier, P.; Clocchiatti, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1986. 6p. (CONF-8608121—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755984/JAW.

From 11. international congress on X-ray optics and microanalysis; London, Canada (4 Aug 1986).

Microanalysis possibilities have been explored to determine light element concentrations within glasses (melt inclusions and basaltic glass fragments) and volcanic phenocrysts. In the first step, C was examined. The study of different spectral interferences lead to calculated detection limits of 40 μg/g for basaltic glasses and 50 μg/g for olivine crystals. The C contents of all investigated specimens range from 40 μg/g (the detection limit) to 6800 μg/g. Heterogeneities were revealed within glass inclusions. Measurements show obvious concentration profiles in basaltic glass samples. Our results agree with previous published data and are reliable. Accuracy of measurements is about 20%. 12 refs.

8467 **(CENBG—8721) Comparative measurement of silicon and major elements (P,S,Cl,K,Ca) in arterial walls using macro and microbeam analysis.** Moretto, P. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires; Bordeaux-1 Univ., 33 (France)). 1987. 179p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756242/JAW.

There are few techniques available for the measurement of silicon at trace levels in biological materials. PIXE and prompt nuclear reaction analysis were used to locate and measure silicon and major elements in arterial walls. Macrobeam analysis, carried out by the Van de Graaff accelerator at CENBG, enabled measurement of mean tissue levels. Microbeam analysis, using the nuclear microprobe at Karlsruhe, yielded the distribution of these elements through the thickness of the arterial wall. The microanalyses were performed on arterial walls from healthy rabbits and the macrobeam study was carried out on the same samples and also on human aorta specimens.

8468 **(CNIC—00142) Analysis of the trace gold by X-ray fluorescence method from excitation of radioisotope source.** Li Jimin; Sun Xiufeng. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Jan 1988. 6p. (In Chinese). (IAE—0036). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705056/JAW.

The determination of the trace gold in solution is described by means of energy dispersive X-ray fluoresecence method from the excition of radioisotope source (/sup 109/Cd), lithium-drifted silicon detector and thin-film technique. The measurement time is 600 seconds. The detection limit can be reduced to 0.15 μg. The precision is better than +-10%. If the gold of 2.58 μg is added in the specimen, the recovery ratio is 91.5%. This method is simple, rapid and accuracy and it may be applied to the determination of gold in many kinds of solutions.

8469 **(CONF-8810112—7) Isolation and purification of uranium from environmental materials for mass spectrometric analysis.** Essling, A.M.; Graczyk, D.G.; Horwitz, E.P. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003597/JAW.

From 34. annual conference on bioassay, analytical and environmental radiochemistry; Las Vegas, NV, USA (17 Oct 1988).

We describe a simple isolation and purification procedure for uranium involving a new one-step separation based on supported-liquid column chromatography, and present experimental results that demonstrate the separation's ability to provide consistent, high uranium recoveries from some typical environmental samples. The uranium product from this procedure is sufficiently pure that no solids are visible on a thermal-ionization mass spectrometer filament after the sample is deposited for analysis. We have used this procedure in determining total uranium in addition to uranium isotopy by adding an isotope-dilution spike to the sample digestate. Because the uranium recovery is good, direct assay of the uranium product by laser fluorimetry or counting techniques is also feasible. 1 fig., 1 tab.

8470 **(DOE/ER/13833—1) [Compensation for peak shifts and variable background responses in fluorescence spectroscopy]: Annual report, February 1, 1988--October 1, 1988.** Rutan, S.C. (Virginia Commonwealth Univ., Richmond (USA)). 1988. Contract FG05-88ER13833. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003434/JAW.

In the past eight months, much of the background research and preparation has taken place. We have focused on the correction for background variability and compensation for solvent dependent peak shifts in fluorescence spectroscopic detection in chromatography. We have initiated a study to determine the optimal derivative order (first, second, or third) for our derivative adaptive Kalman filter background subtraction technique. A program for taking the derivatives of fluorescence spectra and chromatograms has been written and tested. We are conducting our study on the effect of response shifts on the results obtained from the Kalman filter curve resolution algorithm. A study of the effects of solvent polarity on the fluorescence spectra for several different PAH's has been initiated. Thus far, a systematic study of the peak position and shape of perylene in acetonitrile/water mixtures and methanol/water mixtures has been completed. As part of the construction of an intensified diode array spectrofluorometer for on-line collection of three dimensional chromatographic-fluorescence data, a Farrand MK-1 spectrofluorometer (donated from Phillip Morris, Inc.) has been modified to accept the diode array.

8471 **(ENEA-RT-TIB—87-55) Shape and width of IR absorption lines of ammonia expanded in a supersonic jet.** Baldacchini, G.; Snels, M. (ENEA, Rome (Italy)). Apr 1988. 16p. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755360/JAW.

Line width and shape of absorption lines of the v/inf 2/ band vibration of ammonia were measured for a series of transitions starting from vibrational groundstate levels with a different rotational energy. An increase in line width was found for larger rotational energies of the initial states. This effect has been attributed to

the spatial rotational non-equilibrium in the supersonic jet expansion. For expansions of ammonia seeded in He and Ar, a very pronounced dip in the absorption profile has been observed, due to the formation of clusters.

8472 **(INIS-BR—1392) Elemental composition of aerosols sampled in the Brazilian antartic station analyzed by Pixe, EPMA and Absolute principal factor analysis.** Artaxo, P.; Andrade, F.; Maenhaut, W.; Grieken, R. van. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica; Ghent Univ. (Belgium). Inst. for Nucleous Sciences; Antwerp Univ. (Belgium). Dept. of Chemistry). (Bahia Univ., Salvador (Brazil)). 1987. 2p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705187/JAW.

8473 **(INIS-mf—11329) Fast quantification of uranium ores by X-ray fluorescence analysis.** Morales, E.; De la Roca, W. (Seccion Industrial, Direccion General de Energia Nuclear (Guatemala)). (Direccion General de Energia Nuclear, Guatemala City (Guatemala)). Sep 1988. 12p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704918/JAW.

A fast and reliable method for batch quantification of uranium in mineral ores is described. It is based on the verification of the homogeneity of the samples through measuring the ratio of coherent and incoherent dispersion. A few samples, 6 or more, are taken from the whole batch and analyzed by fundamental parameters method. A calibration curve using Lancance-Traill or Lucas-Tooth algorithms is constructed in order that the absorption and enhancement effects could be corrected. Simple interpolation of the intensities of the remaining samples gives their concentration.

8474 (INIS-mf—11860, pp 95-105) **Development of a nuclear physical apparatus for hydrogen detection in solids.** Kalbitzer, S.; Weiser, M.; Zinke-Allmang, M.; Damjantschitsch, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

The nuclear resonance reaction 1H(/sup 15/N,αγ)/sup 12/C is, because of its process parameters, an appropriate means for the detection of hydrogen by means of depth resolution. For reaching a high sensitivity, a 10x10 inch NaI-crystal was placed in an in-line low-level plant of the Heidelberg EN tandem-type accelerator. An ion source integrated into a beam tube system permits an in-situ charging of samples with 1 H at target temperatures of 10-300 K. With this plant it was possible to measure the low-temperature diffusion of 1 H in Ta.

8475 (INIS-mf—11860, pp 106-114) **Investigation of the effects of implanted interstitials on hydrogen diffusion in metals using nuclear physics methods.** Rauch, F. (Frankfurt Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8476 (INIS-mf—11860, pp 115-122) **Kinetic studies in metal-hydrogen systems by analysing the distribution of H and D concentrations.** Rauch, F. (Frankfurt Univ. (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

8477 **(IS—4955) Ames Laboratory quarterly report, October 1, 1987--December 31, 1987.** (Ames Lab., IA (USA)). Feb 1988. Contract W-7405-ENG-82. 83p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89003826/JAW.

This report contains papers on the following topics: laser induced luminescence and multiphoton ionization in gaseous and low temperature matrices; fundamental studies of chemical carcinogenesis by fluorescence line narrowing spectroscopy; analytical applications of supersonic jet spectroscopy; measurement of toxic compounds and metabolites present in environmental and biological samples; and quantitation in electrophoresis based on lasers.

8478 **(NP—9770167) Studies into the matrix-independent quantitative analysis of sulfur by means of chemiluminescence measurements in reducing flames.** Pehl, B. (Wuppertal Univ. ({Gesamthochschule) (Germany, F.R.). Fachbereich 9 - Naturwessenschaften 2 - Chemie - Biologie). 1987. 168p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770167/JAW.

A flame-photometric apparatus for sulfur detection is described, which enables to measure sulfur in concentrations in the ppm (v/v)-level respectively in masses between 9 and 70 nanograms. The measurement is independent on the oxidation state and the type of chemical bond to sulfur in the molecule; influences of other components in the test gases, especially hydrocarbons, were not observed. The presented apparatus works with two vertical positioned flames; the lower flame (decomposition flame) ensures the homogeneity of the sample and the second upper flame (detector flame) takes care for chemical reduction and electronical excitation to the S/sub 2/(B/sup 3/Σ/sup -//sub u/)-state. Extensive experiments in optimizing the operation parameters showed the existence of a 'signal-plateau' in a well defined interval of burner gas composition. The sulfur signal heights were not influenced for given sulfur concentrations in this hydrogen/air range and a maximum response was measured.

8479 **(PB—89-104632/XAB) Development and evaluation of a procedure for determining volatile organics in water (journal version).** Michael, L.C.; Pellizzari, E.D.; Wiseman, R.W. (Research Triangle Inst., Research Triangle Park, NC (USA)). 1988. 8p. NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 22, No. 5, 565-570(May 1988). See also PB—89-104632.

A comprehensive procedure for isolation of volatile organic compounds from various waters was developed through the use of representative volatile organic compounds as part of the EPA Master Analytical Scheme. Preliminary recoveries were determined for a broad range of analytes in distilled water, municipal wastewater effluent, and industrial (energy-related) waste-water effluent. The apparatus for isolation of the compounds form water was interfaced directly to a gas chromatograph-mass spectrometer-computer, and recoveries were determined for compounds comprising different functional groups in drinking water and municipal-industrial waste-water.

8480 **(PNL-SA—15281) Stationary phase interactions in supercritical fluid chromatography.** Yonker, C.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 9p. (CONF-8810218—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002000/JAW.

From International symposium on supercritical fluids; Nice, France (17 Oct 1988).

Solute and solvent interactions with the stationary phase are described. A simple thermodynamic model describing retention in supercritical fluid chromatography (SFC) is used to determine the partial molar volume of the solute in the stationary phase at infinite dilution. Adsorption isotherms for 2-propanol on SE-54 as a function of density, temperature, and mole fraction of 2-propanol were studied for the binary fluid system of 2-propanol/$CO_2$ using SFC-mass spectrometry (MS). The amount of 2-propanol co-solvent sorbed in the stationary phase decreased with increasing pressure of the binary fluid mobile phase. 8 refs., 4 figs., 1 tab.

8481 **(SSI—87-22) Simplified method of analysis of Strontium-90 in milk.** Suomela, J. (National Inst. of Radiation Protection, Stockholm (Sweden)). Jun 1987. 10p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755689/JAW.

The milk sample is freeze-dried and the milk powder ignited. The ash is dissolved in hydrochloric acid and yttrium is extracted from the solution by 5% HDEHP (dioctyl phosforic acid). After

re-extraction in nitric acid the Cherenkov radiation of yttrium 90 is measured in a low beta liquid scintillation counter. (O.S.).

8482 **Photoelectron spectroscopy of $BH^-_3$.** Wickham-Jones, C.T.; Moran, S.; Ellison, G.B. (Department of Chemistry and Biochemistry, University of Colorado, Boulder, Colorado 80309-0215). *Journal of Chemical Physics;* **90**: No. 2, 795-806(15 Jan 1989).

We have studied the photoelectron spectra of $BH^-_3$ and $BD^-_3$ and have measured the electron affinities of borane; we find $EA(BH_3) = 0.038 +- 0.015$ eV and $EA(BD_3) = 0.027 +- 0.014$ eV. The peak splittings and intensities demonstrate that the $BH^-_3$ ion and the $BH_3$ neutral have very similar geometries; our spectra are consistent with a planar structure for both species. Variational calculations of a coupled oscillator basis over an ab initio potential give an excellent fit to the experimental frequencies and photodetachment Franck—Condon factors. This ab initio model leads to equilibrium geometries with both $BH_3$ and $BH^-_3$ as planar molecules with r/sub e/($BH^-_3$) = 1.207 A and r/sub e/($BH_3$) = 1.188 A. We find ΔH/sup circle-open//sub f/$_0$($BH^-_3$) = 23.1 +- 3.8 kcal $mol^{-1}$.

8483 **Tetrakis(dimethylamino)ethylene: identification of impurities and compatibility with common metal, polymer, and ceramic laboratory materials.** Rewick, R.T.; Schumacher, M.L.; Shapiro, S.L.; Weber, T.B.; Cavalli-Sforza, M. (SRI International, Menlo Park, CA (USA)). *Analytical Chemistry;* **60**: No. 19, 2094-2099(1 Oct 1988). Contract AC03-76SF00515.

Analytical procedures were developed that use gas chromatography and gas chromatography/mass spectroscopy techniques to determine the purity of commercially available and purified liquid and gaseous tetrakis(dimethylamino)ethylene (TMAE). More than 20 components were detected; most were identified from their mass spectral fragmentation patterns. The six major TMAE impurities were dimethylamine, tetramethylhydrazine, bis(dimethylamino)methane, dimethylformamide, tetramethylurea, and tetramethyloxamide. The major impurities accounted for greater than 99.5 area % of all impurity components detected. Electron capture analysis of the major TMAE impurities suggested that tetramethyloxamide and tetramethylurea have relative high electron capture cross sections compared with oxygen. Liquid TMAE was observed to be generally compatible (less than 1% decomposition) with 24 commonly used metal, polymer, and ceramic laboratory materials. In some cases, however, low concentrations of products were generated that had a high affinity for electron capture. Materials that formed statistically significant amounts of these products were identified. A technique was developed that uses gas chromatography to measure the major TMAE impurities in a gas flow stream containing TMAE vapor.

8484 **Use of secondary equilibria for the separation of small solutes by field-flow fractionation.** Berthod, A.; Armstrong, D.W.; Myers, M.N.; Giddings, J.C. (Univ. of Missouri, Rolla (USA)). *Analytical Chemistry;* **60**: No. 19, 2138-2141(1 Oct 1988). Contract FG02-88ER13819.

The dynamic range and selectivity of field-flow fractionation (FFF) can be increased by using secondary chemical equilibria (SCE). SCE are established by adding a macromolecular additive or aggregate, which strongly interacts with the field, to the carrier solution. In this study an oil-in-water (O/W) microemulsion was used as the carrier solution in a sedimentation FFF apparatus. The microemulsion droplets (referred to as the support) interact with the field and are retained relative to the bulk water. Small solutes that partition or bind to the microemulsion droplets are also retained relative to solutes that do not interact with the support. In this way it is possible to separate somewhat polar compounds, such as ascorbic acid and sodium benzoate, which prefer bulk water, from apolar solutes, such as toluene, which prefers the support. In addition, the study of retention times in this system allows one to calculate the average microemulsion droplet radius. It appears that SCE-FFF could be a useful way to obtain important information on the physicochemical properties of a variety of colloidal supports.

8485 **(N—88-29003) Determination of impurities in silicon carbide by ICP AES (inductively coupled plasma atomic emission spectrometry) after coprecipitation with lanthanum-hydroxide.** Harada, Y.; Kurata, N.; Furuno, G. (National Aeronautics and Space Administration, Washington, DC (USA)). Sep 1988. Transl. into ENGLISH from Bunseki Kagaku (Japan), Vol. 36, No. 9, 526-531(Sep 1987). (NASA-TT—20332; NAS—1.77:20332). 20p. NTIS, PC A03/MF A01.

Sample decomposition and a method to separate impurities from a matrix are examined to identify the impurities in silicon carbide powder by ICP AES. This method made it possible to determine fifteen elements such as aluminum, iron, which are among the major impurities found in silicon carbide.

8486 **Resonant cell laser-based photoacoustic densitometer for thin-layer chromatography.** Kawazumi, H.; Yeung, E.S. (Ames Laboratory-USDOE and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Applied Spectroscopy;* **42**: No. 7, 1228-1230(Sep 1988).

Photoacoustic spectroscopy was applied to the in situ densitometry of thin-layer chromatographic plates. Fast laser-scanning detection with signal enhancement was demonstrated at a resonant frequency of the cell. The use of phase difference between signal and background provided higher signal-to-noise ratios. Detection limit for Orange G was 170 pg, and the analytical curve was linear over three orders of magnitude.

8487 **A thermodynamic model of nitric acid extraction by tri-n-butyl phosphate.** Chaiko, D.J.; Vandegrift, G.F. (Argonne National Lab., Chemical Technology Div., Argonne, IL (US)). *Nuclear Technology;* **82**: No. 1, 52-59(Jul 1988).

A thermodynamic model is presented for nitric acid extraction by tri-n-butyl phosphate (TBP). This model is based on the formation of the organic phase species: TBP.HNO/sub 3/ and (TBP)/sub 2/.HNO/sub 3/. The model works successfully at TBP concentrations of 5 to 100 vol% and was found to be effective at predicting the extraction of HNO/sub 3/ from HNO/sub 3//NaNO/sub 3/ and HNO/sub 3//LiNO/sub 3/ solutions. Within the TBP concentration range of 5 to 30%, a single set of extraction constants was sufficient to fit extraction data. Stoichiometric activity coefficients of nitric acid in HNO/sub 3//NaNO/sub 3/ and HNO/sub 3//LiNO/sub 3/ mixtures were calculated using a model developed by Bromley.

8488 **Alleviation of overlap interferences for determination of potassium isotope ratios by inductively coupled plasma mass spectrometry.** Jiang, S.J.; Houk, R.S.; Stevens, M.A. (Dept. of Energy, Ames, IA (USA)). *Analytical Chemistry;* **60**: No. 11, 1217-1221(1 Jun 1988). Contract W-7405-ENG-82.

Positioning the sampling orifice relatively far from the load coil combined with use of low forward power and high aerosol gas flow rate causes the background mass spectrum to become dominated by $NO^+$. Nearly all the $Ar^+$ and $ArH^+$ ions are suppressed under these conditions, which frees m/z 39 and 41 for potassium isotope ratio measurements. The precision is 0.3-0.9% relative standard deviation for potassium concentrations in the range 1-50 mg $L^{-1}$. The determined ratios are ~ 9% higher than the accepted value and also vary with the concentration of sodium concomitant, so calibrations and chemical separations are desirable. These observations should permit use of inductively coupled plasma mass spectrometry for rapid isotope ratio determinations of potassium from biological organisms or water sources.

## 4002 Inorganic, Organic And Physical Chemistry

*REFER ALSO TO CITATION(S) 7202, 7224, 7233, 7305, 7306, 7359, 7528, 7538, 7539, 7540, 7558, 7561, 7841, 8160, 8166, 8250, 8392, 8546, 8552, 8570, 9359, 9636, 9805, 9825, 9826*

8489 **(AD-A—197138/1/XAB) Chemical agent simulants for testing transparent materials. Contractor report, September 1987-January 1988.** Lewis, R.E.; Liebman, S.A.; Isaacson, L.; Grasso, P.S.; Sarver, E.W. (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). May 1988. 59p. NTIS, PC A04/MF A01.

Transparent polymeric materials undergo physical changes when exposed to chemical warfare agents. The object of this task was to: 1) select candidate liquids to simulate GB, VX and HD effects (three each) and 2) perform three point bend tests to determine critical strain values for cracking/crazing for simulant/transparent-polymer materials combinations. The critical-strain tests were accomplished using ASTM method D790-80 for stress crazing. The method was modified and enhanced to detect stress crazing via changes in reflection/diffraction patterns produced with a helium-neon (He-Ne) laser. Four transparent-polymer materials were tested; namely, as cast polymethyl methacrylate (PMMA), biaxially stretched PMMA, polycarbonate and polyurethane GAC-590. The critical-strain values obtained for the simulant/polymer combinations are presented as a four-by-nine map that allows easy comparisons as a function of material or simulant. Comparison with actual agent data is possible using this four-by-nine map.

8490 **(AD-A—197725/5/XAB) Gas-phase and solution mechanism of the isotope-exchange reaction $OH^- + D^2 = OD^- + HD$: beam study of the solvated-ion reaction $OH^-.H_2O + D_2$ in the collision energy range 0-2 eV.** Henchman, M.; Paulson, J.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1988. 8p. (AFGL-TR—88-0169). NTIS, PC A02/MF A01.

Pub. in Radiation Physics and Chemistry, Vol. 32, No. 3, 417-423(1988).

The authors' interests have moved away from radiation chemistry into the field of gas-phase ion chemistry-itself a field that was developed from radiation chemistry by radiation chemists. Reaction intermediates are necessarily species of high chemical potential - hard to prepare in a way that will allow them to be identified and characterized. Because radiation chemistry occurs with a large energy deposition, access is provided to high-energy intermediates, facilitating high-energy pathways-generally in a rather indiscriminate way, involving ions, radicals and excited molecules.

8491 **(AD-A—197985/5/XAB) New method for the synthesis of perfluoro-beta, beta-dimethylacrylonitrile. Technical report, August-December 1985.** Hydro, W.R.; King, J.W.; King, C.R. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). May 1988. 21p. (CRDEC-TR—88106). NTIS, PC A03/MF A01.

The title compound was prepared in modest yield by treatment of perfluoroisobutylene (PFIB) in acetonitrile solvent with potassium cyanide in the presence of 18-crown-6 ether catalyst. Product formation in the time course of the reaction was observed to follow a Gaussian rather than a plateau profile; maximum concentration occurred between 60 and 70 min with incomplete conversion of the PFIB. A major by-product of the reaction was tentatively identified as a condensation product of the PFIB and title compound. Reaction mechanisms consistent with experimental results are proposed to explain product and by-product formation. Suggestions for further work are proposed.

8492 **(AD-A—198076/2/XAB) Laser-dye synthesis; Group F compounds. Final report, March-July 1987.** Grubbs, E.J. (San Diego State Univ. Foundation, CA (USA)). Feb 1988. 11p. NTIS, PC A03/MF A01.

This report describes progress toward the syntheses of new potential laser dyes. It is anticipated that new substrates will allow upscaling of flashlamp-pumped dye lasers to higher energies. The criteria for assessment of these dyes include a) the extent to which they show a lower, laser action threshold, b) their operational efficiencies, and c) their photochemical stabilities compared with laser dyes previously evaluated. In principle, high optical quality and convenient cooling are obtainable using a flow system. Also, costs should be relatively small compared with those for solid-state lasers if reasonably short, high-yield synthetic routes can be found. Pavlopoulos has proposed that improvements in presently available laser dyes may be realized by restricting chromophores and auxochromic groups to coplanarity or near coplanarity. The desired result of imposing these structural conditions is the reduction of intersystem crossing and thus improvements in quantum-fluorescence yields. The targeted compounds described were designed to meet these objectives.

8493 **(AD-A—198187/7/XAB) Laser-dye synthesis - Group C compounds. Final report.** Grubbs, E.J. (San Diego State Univ. Foundation, CA (USA)). Jan 1988. 11p. NTIS, PC A03/MF A01.

This report describes progress on the syntheses of a number of new potential laser dyes. The goal is to generate new structures allowing the upscaling of flashlamp-pumped dye lasers to high energies. These systems ideally should show a lower laser-action threshold, operate with high efficiencies, and exhibit greater photochemical stabilities than do those presently available. Pavlopoulos has proposed a) that the parent aromatic chromophores be substituted by auxochromic groups such as hydroxy, alkoxy, and dialkylamino, and b) that improvement should result by restricting the chromophore and auxochromic group to coplanarity. This should reduce intersystem crossing and thus improve the quantum-fluorescence yield. The potential dye lasers described below are designed to meet these objectives.

8494 **(AD-A—198242/0/XAB) Novel imidazolium oximes as improved nerve-agent antidotes. Final report, April 1986-November 1987.** Koplovitz, I.; Stewart, J.R. (Army Medical Research Inst. of Chemical Defense, Aberdeen Proving Ground, MD (USA)). Jul 1988. 24p. (USAMRICD-TR—88-06). NTIS, PC A03/MF A01.

Four compounds from a large series of N,N disubstituted imidazolium - aldoximes were identified in the mouse as potential lead candidates for an improved nerve-agent antidote. The potency and efficacy of these compounds in combination with atropine were evaluated against lethality from the nerve agents soman, sarin, tabun, and VX. Also, the authors evaluated the effect of the imidazolium oximes on recovery from debilitation 24 hours after soman poisoning. The results suggest that the imidazolium oximes, as a class, may have much utility in the treatment of nerve agent poisoning. Their potential therapeutic benefit deserves further exploration in advance animal models.

8495 **(CNIC—00082) Techniques for preparing isotopic targets.** Xu Guoji; Guan Shouren; Luo Xinghua; Sun Shuhua. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Dec 1987. 8p. (In Chinese). (IAE—0022). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705037/JAW.

The techniques of making isotopic targets for nuclear physics experiments are introduced. Vacuum evaporation, electroplating, centrifugal precipitation, rolling and focused heavy-ion beam sputtering used to prepare various isotopic targets at IAE are described. Reduction-distillation with active metals and electrolytic reduction for converting isotope oxides to metals are mentioned. The stripping processes of producing self-supporting isotopic targets are summarized. The store methods of metallic targets are given.

8496 **(DOE/ER/13297—1) [Alkane photoreactions with mercury vapor]: [Progress report].** Crabtree, R.H. (Yale Univ., New Haven, CT (USA)). [1988]. Contract FG02-84ER13297. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003354/JAW.

We have learned how to make methane take part in our vapor phase mercury photosensitized dehydrodimerization reactions. Methane has too strong a C-H bond for it to be able to react under the usual conditions. We have found that the addition of

$N_2O$/MeOH allows reaction with methane and with other substrates having strong C-H bonds. We now have a good mechanistic understanding of the reaction, and can predict the product distributions to be expected for the reactions of simple alkanes.

8497 **(DOE/ER/13773—1) Model catalyst studies of active sites and metal support interaction on vanadia and vanadia-supported catalysts: Progress report for the period, 1 September 1987--30 November 1988.** Henrich, V.E. (Yale Univ., New Haven, CT (USA). Dept. of Applied Physics). Sep 1988. Contract FG02-87ER13773. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003681/JAW.

We have been proceeding in two directions in our research on strong metal-support interactions and the nature of active sites on vanadia catalysts. In our work on model $Rh/TiO_2$ catalysts fabricated on single-crystal supports, we have prepared and characterized the stoichiometric and the reduced $TiO_2$ (110) supports, with and without monolayer amounts of Rh. We are using UPS to determine the electronic structure of single Rh atoms bonded to surface cations on $TiO_2$, and then to follow the way in which that changes as small Rh particles form on the surface. In addition, we have begun studies of the oxidation of V by using UPS, XPS, Auger and EELS spectroscopies in order to find procedures by which we can produce surfaces containing predominantly a single type of active site. We have identified a precursor adsorbed state of oxygen on V and have produced surfaces containing predominantly $V^{3+}$ ions. These surfaces will be used in HREELS studies of the detailed way in which different molecules interact with such sites. 4 figs.

8498 **(DOE/ER/13775—1) [Mechanistic examination of organometallic electron transfer reactions]: [Progress report].** (State Univ. of New York, Albany (USA). Research Foundation). [1988]. Contract FG02-87ER13775. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004128/JAW.

Efforts have been directed toward construction of an infrared, stopped-flow spectrophotometer. This was essentially accomplished by July 1, 1988. We have also made progress on the reactions of metal carbonyl anions with metal carbonyl cations and metal carbonyl dimers. Reactions of $Re(CO)_5^-$ with $Mn(CO)_6^+$, phosphine, inorganic complexes and organometallic halides are discussed. 3 figs.

8499 **(DOE/ER/13836—1) A spectroscopic and catalytic investigation of active phase-support interactions: Progress report, 15 January 1988--15 October 1988.** Haller, G.L. (Yale Univ., New Haven, CT (USA). Dept. of Chemical Engineering). Nov 1988. Contract FG02-88ER13836. 9p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004125/JAW.

We report on progress in the analysis of metal-oxide interaction, oxide-oxide interaction and an improved EXAFS analysis to be applied to metal-metal interaction. The metal-oxide interaction is that between Ag and $TiO_2$ support where surface compound formation is observed. This strong interaction between Ag and $TiO_2$ leads to high dispersions of Ag but this is not catalytically useful because the Ag is deactivated for all reactions investigated including CO oxidation. The oxide-oxide interaction is between surface silica added as a structural promotor of alumina. The $^{29}Si$ NMR spectra indicate that this surface silica is in two environments. One is not different from bulk silica and is assigned to a separate silica phase which does not bond to the alumina surface. A second silica is in an environment bonded to alumina with very distorted tetrahedral angles. We argue that this silica phase essentially forms silica chains over the alumina surface and it is observed to correlate with the degree of alumina stabilization against loss of surface area and porosity. 7 refs., 4 figs., 1 tab.

8500 **(DOE/ER/13855—1) Stable isotope studies: Progress report, March 1988 to October 1988.** Ishida, T. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). 21 Oct 1988. Contract FG02-88ER13855. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003288/JAW.

We have engaged in the experimental and theoretical studies in three subfields of isotope science and technology including studies of electric potential-assisted heterogeneous catalysis (EPAC) of hydrogen isotope exchange reaction between water and dihydrogen, correlation of vibrational zero-point energy with intra- and inter-molecular forces, and studies of liquid ammonia systems. 4 refs.

8501 **(IPNO-DRE—88-27) Hydration numbers of trivalent lanthanide and actinide ions.** David, F.; Fourest, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756253/JAW.

The structure of the trivalent lanthanide and actinide aquo ions has been investigated recently through radiochemical methods based on transport properties. The volume V/sub t/ of the aquo ions was deduced. The variation of V/sub t/ vs. the crystallographic radius shows a discontinuity corresponding to a change in the hydration number. New evaluations of the volume of the water molecules in the vicinity of the cation are obtained in this work using electrostriction theory. More accurate values of the dynamic hydration number are calculated for all the members of the series. 30 refs.

8502 **(LBL—25542) Regeneration of basic sorbents used in the recovery of acetic acid from dilute aqueous solution.** Ng, M.; King, C.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 67p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89002964/JAW.

The regeneration of basic sorbents used in the recovery of dilute aqueous acetic acid was explored. The regeneration methods studied were solvent leaching and vaporization. The resins used were weak base anion exchange resins, Dow Chemical Company's Dowex MWA-1 (tertiary amine resin) and Celanese Corporation's Aurorez (polybenzimidazole resin). The equilibrium between the aqueous acetic acid solution and the resins was measured in batch experiments. The composite isotherms calculated from these data wee comparable to those of other researchers. Methanol was used as the solvent to leach acetic acid from the resin. The equilibrium data from the batch experiments were used in the local-equilibrium theory of fixed-bed devices to model the desorption behavior of acetic acid in methanol. Both sorption and desorption equilibrium data were used in chemical complexation models to obtain sorption affinities and capacities of the resin for acetic acid. However, the amount of methanol needed to achieve a high degree of regeneration was too large to be economical. 15 refs., 25 figs., 3 tabs.

8503 **(LBL—26124) Tris(cyclopentadienyl)cerium and -uranium: Relative basicity, structure, and reactions.** Stults, S.D. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 198p. NTIS, PC A10/MF A01 - OSTI. Order Number DE89002946/JAW.

The trivalent cerium complexes $(RC_5H_4)_3Ce$ {center←dot} L have been prepared and structurally characterized in order to study the relative basicity of neutral donor ligands toward $(RC_5H_4)_3Ce$. The steric properties of the metal environment and the steric and electronic properties of the donor ligand influence complex stability. The base-free metallocenes, $(RC_5H_4)_3Ce$, react with a number of protic reagents to form stable $[(RC_5H_4)_2CeX]_2$ complexes via a ring protonation reaction. The reagent pKa values govern the thermodynamics of the reaction. The steric bulk of the protic substrate and the cyclopentadienyl ligands can be altered to achieve kinetically stable compounds. In contrast, the analogous uranium complexes, $(RC_5H_4)_3U$, react in an oxidative manner with protic reagents to form $(RC_5H_4)UX$ complexes. The base-free cerium metallocenes also react with methyllithium to afford bis(cyclopentadienyl)cerium methyl complexes. Other alkyl complexes cannot be prepared in a similar manner. The cerium methyl complexes readily polymerize ethylene, and they react with phenylacetylene, hydrogen, and ammonia to yield the bridging acetylide, hydride, and amide complexes, respectively. The uranium metallocene, $(MeC_5H_4)_3U$ {center←dot} thf, reacts with methyllithium at low temperature ({minus}30{degree}C) in the presence of $Me_2NCH_2CH_2NMe_2$ (tmed) to form a complex that contains a methyl group that is linearly and symmetrically bridging between two $(MeC_5H_4)_3U$ groups, and a $MeC_5H_4$ group that is sandwiched between two Li(tmed) fragments. 149 refs., 35 figs., 40 tabs.

**8504 (MLM—3552(OP)) Hydrogen isotope exchange via water exposure at oxyhydroxide surfaces of stainless steel and silicon.** Gill, J.T.; Watkins, D.B.; Schultz, J.A.; Anderson, L.R.; Schmidt, H.K.; Bastasz, R.J. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 1988. Contract AC04-88DP43495;AC04-76DP00789. 21p. (CONF-881002—27). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003444/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

The rates at which hydrogen isotopes are exchanged on oxyhydroxide surface films of 304L stainless steel and Si(100) upon exposure to water vapor have been investigated. Surface films were prepared by bombardment with $D_2O^+$. The surfaces were then monitored by SIMS and Direct Recoil Spectroscopy as a function of water ($H_20$ or $D_2O$) exposure. A fast and a second much slower process characterize the exchange at both films. The processes are isotopically reversible. The fast process is limited by water exposure, complete in 5--10 L for both materials, and is considered to involve terminal hydroxyl groups. The slow process appears to be the bulk diffusion-limited exchange within the oxyhydroxide film. Exchange-diffusion constants have been derived from fits to TRIM calculations for depth-of-origin of sputtered species: D/sub ex/-$10^{-18}$ and $10^{-19}$ $cm^2$/sec for the films on 304LSS and Si, respectively, at 295K. These values are invariant (within a factor of 10) upon the choice of three widely different TRIM inputs. D/sub ex/ for 304LSS is consistent with previous results on FeOOH and SS. Diffusion exchange appears important in understanding tritium decontamination from surfaces. 47 refs., 8 figs.

**8505 (N—88-29893) Computed potential energy surfaces for chemical reactions. Semiannual report, 1 January-30 June 1988.** Walch, S.P. (Eloret Corp., Sunnyvale, CA (USA)). Sep 1988. 42p. (NASA-CR—183168; NAS—1.26:183168). NTIS, PC A03/MF A01.

The minimum energy path for the addition of a hydrogen atom to $N_2$ is characterized in CASSCF/CCI calculations using the (4s3p2d1f/3s2p1d) basis set, with additional single point calculations at the stationary points of the potential energy surface using the (5s4p3d2f/4s3p2d) basis set. These calculations represent the most extensive set of ab initio calculations completed to date, yielding a zero point corrected barrier for $HN_2$ dissociation of approx. 8.5 kcal mol/1. The lifetime of the $HN_2$ species is estimated from the calculated geometries and energetics using both conventional Transition State Theory and a method which utilizes an Eckart barrier to compute one dimensional quantum mechanical tunneling effects. It is concluded that the lifetime of the $HN_2$ species is very short, greatly limiting its role in both termolecular recombination reactions and combustion processes.

**8506 (PNL-SA—16041) Auger parameter measurements of phosphorus compounds for characterization of phosphazenes.** Dake, L.S.; Baer, D.R.; Friedrich, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 21p. (CONF-881002—23). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003139/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

This paper presents x-ray generated photoelectron and Auger transition data for several phosphorus reference compounds, including $PCl_3$, $P_3N_5$, $P_2O_5$, $(C_6H_5)_3P(C_5H_4)$, $(C_6H_5)_4PBr$, $KH_2PO_4$ (KDP), $NH_4H_2PO_4$ (ADP), and $NH_4PF_6$. This data has been used to determine the relative ionicity and polarizability of phosphorus in the chlorophosphazene trimer ($[NPCl_2]_3$) and polymer ([$NPCl_2$]/sub n/). The results support recent molecular orbital calculations that predict a highly polarized backbone bond in the phosphazenes. Furthermore, the chlorophosphazene polymer was observed to have a greater value for the Auger parameter than the chlorotrimer, indicating that the media surrounding the polymer is more polarizable than that surrounding the trimer. 15 refs., 2 figs., 2 tabs.

**8507 (SAND—88-3078C) Computer-aided molecular design of methane-activation catalysts.** Shelnutt, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 11 Nov 1988. Contract AC04-76DP00789. 18p. (CONF-8811105—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003235/JAW.

From Indirect liquefaction contractor's review meeting; Pittsburgh, PA, USA (16 Nov 1988).

A methodology for developing new catalysts using computer-aided molecular design (CAMD) techniques is being developed and applied to selective alkane hydroxylation. An iterative procedure for designing catalysts includes several tasks: (1) investigation of enzymes to learn what structural features to build into the synthetic catalyst; (2) use of CAMD methods to find synthesizable catalysts with the required molecular features; (3) synthesis of potential catalysts identified in the CAMD studies; (4) structural and chemical characterization of the synthetic catalysts to verify that the molecular structures are those desired; and (5) measurements of catalytic activity and stability of the designed catalysts. The structural characterization and catalytic activity determinations provide information from which the CAMD predictions can be evaluated. More importantly, the resulting structure-activity relationships give a basis for further improvements in catalyst design. 4 refs., 25 figs., 1 tab.

**8508 (UCID—21406) MCRT user's guide and documentation.** Jackson, K.J.; Wolery, T.J.; Bourcier, W.L.; Delany, J.M.; Moore, R.M.; Clinnick, M.L.; Lundeen, S.R. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1988. Contract W-7405-ENG-48. 99p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89004607/JAW.

MCRT is a FORTRAN computer program used to generate computer files containing thermodynamic data for chemical reactions involving solids, gases, and aqueous species. The MCRT code uses basic thermodynamic and reaction stoichiometry information stored in data and input files to produce an output file containing a grid describing the temperature dependence of equilibrium constants of mineral hydrolysis reactions and aqueous dissociation reactions. These reaction properties comprise a critical portion of the thermodynamic data needed by the geochemical modeling codes in the EQ3/6* software package. The set of files used to store the thermodynamic data for the aqueous, solid, and gaseous species and associated FORTRAN data base manipulation codes are also described in this user's manual. However, the data base structure and use of the data manipulation programs are described only in enough detail to illustrate their relationship to the operation of the MCRT code. This user's guide is designed to acquaint a new user with the MCRT program and its associated data files, and to assist in the use of the code and its various options. The data base processing codes MDAP and DARP are briefly described and several sample runs of the programs are included to illustrate the options available. In addition, the structure of the MCRT code, the coding conventions used in the EQ3/6 package, and the methods used in MCRT to extrapolate thermodynamic data to elevated temperatures are described. Appendices contain descriptions of the important variables defined in MCRT and a glossary of subroutines called by MCRT, along with their purposes. 6 figs.

**8509 On Liapunov functions for single-variable reacting systems displaced from equilibrium.** Hunt, K.L.C.; Hunt, P.M.; Ross, J. (Department of Chemistry, Michigan State University, East Lansing, Michigan 48824-1322). *Journal of Chemical Physics;* **90**: No. 2, 880-887(15 Jan 1989).

We prove that Liapunov functions for a single reactive intermediate evolving toward a nonequilibrium steady state can be obtained from a global potential phi. We consider reactions occurring in a chamber containing a reactant, the intermediate, and a product. Reservoirs connected to the chamber serve to hold the reactant and product concentrations constant, in nonequilibrium proportions. The Liapunov property of phi is significant because of the role it plays in the thermodynamic and stochastic analysis of nonequilibrium systems: phi is defined in terms of the reactive flux to produce the intermediate and the flux to remove the intermediate. The derivative of phi with respect to the concentration of the intermediate yields an effective chemical driving force that is specific to the intermediate, and its time derivative yields a species-specific component of the dissipation that is minimized at steady states. These results hold both near to equilibrium and far from equilibrium for systems with one intermediate, independent of the number of steady states. Local Liapunov functions are also provided by the "excess dissipation," the second variation in the entropy or in the Helmholtz free energy for the reaction chamber, and quadratic

functions introduced in Keizer's fluctuation—dissipation theory. Linearization of the force and flux expansions for nonequilibrium systems yields an idealized model in which the dissipation decreases monotonically in time and thus provides a Liapunov function for evolution to steady states. This result does not hold for a chemical system approaching a steady state with an arbitrarily small, but macroscopic displacement from equilibrium, even though the series expansions of the reactive fluxes and conjugate thermodynamic forces are closely approximated by truncation at the linear terms.

8510 **Silaketene: A product of the reaction between silylene and carbon monoxide?.** Hamilton, T.P.; Schaefer H.F. III. (Center for Computational Quantum Chemistry, School of Chemical Sciences, University of Georgia, Athens, Georgia 30602). *Journal of Chemical Physics;* **90**: No. 2, 1031-1035(15 Jan 1989).

Molecular structures and vibrational frequencies for silaketene, $H_2SiCO$, are predicted using ab initio techniques. A weakly bound nonplanar structure is found to be the equilibrium geometry, whereas the ketene-like planar structure is the transition state for inversion between the two equivalent nonplanar conformations. The barrier to inversion about the silicon atom is 18 kcal/mol. The ab initio heat of reaction of $SiH_2$ and CO to form $H_2SiCO$ is 16 kcal/mol. The results are discussed in light of recent matrix isolation experiments attempting to make and detect dimethylsilaketene.

8511 **Diffusion theory of multidimensional activated rate processes: The role of anisotropy.** Kl-dash-barosek-Dygas, M.M.; Hoffman, B.M.; Matkowsky, B.J.; Nitzan, A.; Ratner, M.A.; Schuss, Z. (Department of Mathematics, University of California, Davis, California 95616). *Journal of Chemical Physics;* **90**: No. 2, 1141-1148(15 Jan 1989).

We consider an anisotropic multidimensional barrier crossing problem, in the Smoluchowski (diffusion) limit. The anisotropy arises from either or both the shape of the potential energy surface and anisotropic diffusion. In such situations, the separatrix, which separates reactant and product regions of attraction, does not coincide with the ridge of the potential surface, which separates reactant and product wells, thus giving rise to a complicated time evolution. In the asymptotically long time limit, the time evolution is governed by crossing the separatrix and is exponential with a rate which may be obtained as a generalization of Kramers' theory to the anisotropic situation. In contrast, in long, though not asymptotically long times, the time evolution is dominated by repeated crossings of the ridge, and is nonexponential. Such nonexponential time evolution has been observed in many biochemical reactions, where many degrees of freedom and anisotropic diffusion processes lead to complicated dynamical behavior. Our model provides a simple prototype of such situations.

8512 **High temperature thermodynamic studies of some gaseous thorium fluorides.** Lau, K.H.; Brittain, R.D.; Hildenbrand, D.L. (SRI International, Menlo Park, California 94025). *Journal of Chemical Physics;* **90**: No. 2, 1158-1164(15 Jan 1989).

The gaseous species ThF, $ThF_2$, $ThF_3$, and $ThF_4$ were generated in a heated effusion beam source, and were identified and characterized by mass spectrometry. An oxygen impurity in the sample also led to the characterization of the gaseous oxyfluoride ThOF. Reaction equilibria involving these species were studied over large temperature ranges, leading to the derivation of both enthalpy and entropy data for these species. The vapor pressure and vaporization thermodynamics of $ThF_4(s)$ were also determined. Derived bond dissociation energies in $ThF_4$ oscillate about a mean value of 670 +- 25 kJ $mol^{-1}$, with a distinct pattern similar to other metal tetrafluorides. Absolute entropies calculated from the equilibrium data indicate moderate electronic level contributions for the odd-electron molecules ThF and $ThF_3$, but not for the even-electron species $ThF_2$ and $ThF_4$. Furthermore, the experimental entropy of $ThF_4$ is compatible with a regular tetrahedral configuration, rather than the distorted configuration of lower symmetry found earlier for $UF_4$ and $UCl_4$. Thermochemical properties of the Th—F species are presented and the comparison with the corresponding uranium fluorides is discussed.

8513 **Picosecond dynamics of surface electron transfer processes: Surface restricted transient grating studies of the n-$TiO_2$/$H_2O$ interface.** Kasinski, J.J.; Gomez-Jahn, L.A.; Faran, K.J.; Gracewski, S.M.; Miller, R.J.D. (Department of Chemistry and the Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14627). *Journal of Chemical Physics;* **90**: No. 2, 1253-1269(15 Jan 1989).

The surface restricted transient grating is demonstrated as a sensitive probe of ultrafast surface reaction dynamics. Studies of doped single crystal n-$TiO_2$ (001) surfaces in air demonstrate linear trapping processes, assigned to crystal defects within the surface deformation layer, that limit carrier lifetimes to 5 ns. Direct in situ grating studies at photochemically active n-$TiO_2$/$H_2O$ interfaces demonstrate that the dominant mechanism of interfacial electron transfer in this system involves thermalized hole carriers at the atomic surface. The dynamics are consistent with adsorbed $OH^-$ as the initial hole acceptor. In addition, optical generation of coherent surface acoustic modes is demonstrated. A detailed theory is presented for the grating excitation of the surface acoustics. Acoustic propagation in the $H_2O$ half-space of the $TiO_2$/$H_2O$ liquid interface gives evidence for a phase change of the water layer at the polar $TiO_2$ (001) surface to a solid phase.

8514 **Comment on the role of reaction path curvature in diffusional barrier crossing processes.** Larson, R.S. (Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **90**: No. 2, 1291-1292(15 Jan 1989).

Recently, some doubt has arisen regarding the importance of reaction path curvature in affecting the rate of diffusional barrier crossing processes. In particular, it has been argued that correction terms previously attributed to curvature can instead be traced to other features of the potential energy surface. It is shown here that, while curvature is not the only possible cause of deviations from the conventional rate expression, its effect is nonetheless very real.

8515 **Comment on: X-ray diffraction study of the effects of pressure on bilayer to nonbilayer lipid membrane phase transitions.** Shyamsunder, E.; Botos, P.; Gruner, S.M. (Physics Department, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics;* **90**: No. 2, 1293-1295(15 Jan 1989).

X-ray diffraction data of aqueous dispersions of dioleoylphosphatidylethanolamine (DOPE) have been obtained as a function of pressure and temperature. The well-known lamellar (L/sub $\alpha$/) to inverted hexagonal (H/sub II/) thermotropic phase transition that occurs in DOPE at about 6 °C at ambient pressure can be reversed at 20 °C when the pressure is increased from 1 to 500 bar. X-ray data in which the temperature is varied at fixed pressures shows that the increase in dP/dT/sub B//sub H/ is about 20 bar/K.

8516 **Spectroscopy of phenylacetylene bound to clusters of ammonia and the surface cluster analogy.** Breen, J.J.; Kilgore, K.; Tzeng, W.; Wei, S.; Keesee, R.G.; Castleman A.W. Jr. (Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Chemical Physics;* **90**: No. 1, 11-18(1 Jan 1989).

The results of a systematic study of the spectra shifts of the $S_1$—$S_0$ transition in phenylacetylene (PA) [$^1B_2$($^1$L/sub b/)leftarrow$^1A_1$($^1$A)] due to solvation by $NH_3$ are reported based on two-photon REMPI. A unique aspect of the present work is comparison of the red shifts for clusters produced by coexpansion techiques with those where PA is attached to performed ammonia clusters. In both experiments the 1—1 complex is red shifted by 80 $cm^{-1}$. In the case of the coexpansion experiments the red shift is about 50 $cm^{-1}$ for PA($NH_3$)/sub n/, n = 2—7. By contrast, the clusters produced by attachment display a much different and gradually increasing red shift which saturates at 150 $cm^{-1}$ for n = 13 and beyond. Structural differences for clusters produced by the two different techniques are believed to be responsible.

8517 **Intracluster reactions in phenylacetylene ammonia clusters initiated through resonant enhanced ionization.** Breen, J.J.; Tzeng, W.; Kilgore, K.; Keesee, R.G.; Castleman A.W. Jr. (Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Chemical Physics;* **90**: No. 1, 19-24(1 Jan 1989).

Protonated ammonia clusters of specific size are observed to form following the resonant enhanced ionization of phenylacetylene—ammonia clusters PAx(NH$_3$)/sub n/ in the $0^0_0$ region of the $S_1$—$S_0$ transition of the (unclustered) PA. The resonance enhanced absorption of two photons, ≃8.8 eV total energy, are found to cause intracluster reactions for n≧5. The findings imply that the adiabatic ionization potential of $(NH_3)_4$ is greater than 8.8 eV, while that of $(NH_3)_5$ is (slightly) less.

8518 **Rate constant for the reaction $O(^3P)+D_2$ at low temperatures.** Zhu, Y.; Arepalli, S.; Gordon, R.J. (Department of Chemistry, University of Illinois at Chicago, Box 4348, Chicago, Illinois 60680). *Journal of Chemical Physics;* **90**: No. 1, 183-188(1 Jan 1989).

The rate constant for the reaction of $O(^3P)+D_2$ was measured over the temperature range 343 to 446 K using the laser photolysis—resonance fluorescence technique. The results can be fit well with a two-parameter Arrhenius function and are in excellent agreement with the previous measurements of Presser and Gordon and with the recent high temperature measurements of Michael. The data are also in very good agreement with the theoretical calculations of Joseph et al. and of Bowman et al. and demonstrate that tunneling makes a significant contribution to the rate coefficient over the entire range of temperatures studied in this experiment. The Arrhenius behavior of the rate constant supports the conclusions of Robie et al. in their study of the intramolecular isotope effect in $O(^3P)+HD$, where it was found that tunneling plays a major role at low temperatures.

8519 **Rate constants for the reaction $O+D_2 \rightarrow OD+D$ by the flash photolysis—shock tube technique over the temperature range 825—2487 K: The $H_2$ to $D_2$ isotope effect.** Michael, J.V. (Gas Phase Chemical Dynamics Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **90**: No. 1, 189-198(1 Jan 1989).

Rate constants for the reaction of $O(^3P)$ atoms with deuterium, $O+D_2 \rightarrow OD+D$, have been measured over the temperature range 825—2487 K. The experimental method that has been used is the flash photolysis—shock tube (FPST) technique. This technique utilizes atomic resonance absorption spectroscopy (ARAS) to monitor O-atom depletion in the presence of a large excess of reactant, $D_2$. The measurement is made in the stagnant reflected shock wave region. Thus, shock heating simply serves to prepare the gas density and temperature for a flash photolytically induced absorption photometric experiment. The results that have been obtained between 825 and 2487 K can be represented by the Arrhenius expression: $k = (3.22 \pm 0.25) \times 10^{-10} \exp(-7293 \pm 98\ K/T)\ cm^3\ molecule^{-1}\ s^{-1}$. The average deviation of the present data from this equation is ±17%. An alternative three parameter expression that represents the data to within ±16% is $k = 1.95 \times 10^{-15}$ T/sup 1.45/ exp(-5250 K/T) $cm^3$ $molecule^{-1}$ $s^{-1}$. When the recent results of Zhu, Arepalli, and Gordon (the preceding paper) are considered, a three parameter expression can be determined for the temperature range, 343—2487 K. This combined result is $k = 2.43 \times 10^{-16}$ T/sup 1.70/ exp (-4911 K/T) $cm^3$ $molecule^{-1}$ $s^{-1}$. The average deviation of the data from this equation is ±16%, whereas the data of Gordon and co-workers agree to within ±5%.

8520 **Infinitely polydisperse fluids.** Kofke, D.A.; Glandt, E.D. (Department of Chemical Engineering, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6393). *Journal of Chemical Physics;* **90**: No. 1, 439-447(1 Jan 1989).

A generalized semigrand formalism for polydisperse fluids is presented and is used to derive a thermodynamic consistency equation. In the infinitely polydisperse limit: corresponding to a flat distribution of chemical potential differences: a characteristic parameter is eliminated, and the description of the mixture is greatly simplified. In the case of infinitely polydisperse hard spheres, the absence of a characteristic diameter implies that all quantities must scale to the density, which provides the only length. This leads to an exact equation of state which, remarkably, is PV/Nk/sub B/T = 4/3 at all densities. The treatment is generalized, to show that there exists a whole family of stationary composition distributions which have invariant compressibility factors. Monte Carlo simulation is used to verify these results, and applications to other potentials are discussed. Infinitely polydisperse fluids provide a convenient starting point for new mixture theories.

8521 **Reevaluation of the viscosity exponent for binary mixtures near the consolute point.** Nieuwoudt, J.C.; Sengers, J.V. (Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *Journal of Chemical Physics;* **90**: No. 1, 457-462(1 Jan 1989).

A reevaluation of the critical exponent of the viscosity anomaly for binary mixtures close to the consolute point is presented. Using published data we make a systematic, consistent study in which corrections due to shear gradients and frequency effects are included and the effect of the functional form for the background viscosity is critically examined. The result is that the value of the exponent is generally found to be larger than reported and larger than the most recent theoretical predictions.

8522 **Basis set additivity in calculation of ionization potentials of AH/sub n/ compounds.** Curtiss, L.A.; Pople, J.A. (Argonne National Laboratory, Chemical Technology Division/Materials Science Program, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **90**: No. 1, 603-605(1 Jan 1989).

The use of a basis set additivity approximation for the calculation of ionization potentials of AH/sub n/ compounds has been tested for $NH_3$ and found to be valid. The calculated ionization potentials for $NH_2 \rightarrow NH^+{}_2(^3B_1)$ and $NH_2 \rightarrow NH(^1A_1)$ remain in good agreement with experiment.

8523 **Interactions of CO and surface K: Negligible CO adsorption on K/Ag(111).** Roop, B.; Blass, P.M.; Zhou, X.; White, J.M. (Department of Chemistry, University of Texas, Austin, Texas 78712). *Journal of Chemical Physics;* **90**: No. 1, 608-609(1 Jan 1989).

Unlike transition metals which are active for chemisorption of CO, Ag(111) shows no tendency to adsorb CO at 100 K even when various amounts of K are added. This observation supports the proposal of Solymosi and Berko (Ref. 1) that bonding of CO with the host metal plays an important role in the interactions of K and CO on transition metals.

8524 **Laser ionization spectroscopy of $CD_3$ via the 3p/sub z/ $^2A''_2$ Rydberg state.** Parker, D.H.; Wang, Z.W.; Janssen, M.H.M.; Chandler, D.W. (Department of Chemistry, University of California Santa Cruz, Santa Cruz, California 95064). *Journal of Chemical Physics;* **90**: No. 1, 60-67(1 Jan 1989).

Nascent $CD_3$ radicals produced by photodissociation of $CD_3I$ after absorption of 266 nm radiation by the A-italic-tilde state are studied using the photofragment imaging technique. Two-photon, resonance-enhanced, multiphoton ionization [(2+1) REMPI] probes $CD_3$ via the 3p/sub z/ $^2A'_2$ Rydberg excited electronic state. $CD_3I$ photodissociation at 266 nm is found to produce ground-electronic-state $CD_3$ radicals with substantial vibrational excitation of the $\nu_2$ umbrella mode. Rotational constants are determined for v = 0, 1, and 2 of $\nu_2$ in the 3p/sub z/ excited state by analysis of the spectra. A first-order perturbation and diagonalization procedure is used to generate potential energy curves for the umbrella mode in both the ground and excited electronic states and Franck—Condon factors for various transitions between the states. These results should prove useful when employing REMPI to characterize methyl radicals in many environments.

8525 **Interaction between adsorbed chalcogen and Al atoms on Al(001).** Feibelman, P.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12133-12138(15 Dec 1988).

First-principles, scattering-theory-based calculations for Al-S and Al-Te dimers adsorbed on a rigid Al(001) film show in both cases that the ad-Al and the chalcogen repel each other when forced to reside in neighboring hollows. This result, which stems from the fact that the through-metal effective repulsion is not compensated by a sufficiently attractive direct adatom interaction, indicates the importance of establishing whether there are any laws governing the nature of the interactions between surface additive atoms and various types of surface defects.

8526 **Synchrotron photoemission study of CO chemisorption on Cr(110).** Shinn, N.D. (Surface Science Division, National Institute of Science and Technology, Gaithersburg, Maryland 20899). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12248-12258(15 Dec 1988).

Angle-integrated ultraviolet photoemission studies of carbon monoxide chemisorption on Cr(110) confirm the sequential population of two electronically inequivalent molecular binding states ($\alpha_1$/sub -/CO and $\alpha_2$/sub -/CO) at 90 K. These are distinguished by differences in the CO $4\sigma$ binding energies ($\Delta$E/sub B/ = 0.8 eV) and photoemission cross sections. Work-function measurements indicate that the surface dipole moment associated with $\alpha_1$-CO is significantly less than that for $\alpha_2$-CO. CO/O interaction data exhibit oxygen-induced $\alpha_1$-CO site blocking and $\alpha_1$/sub -/CO→$\alpha_2$-CO binding mode conversion. These results support current models for the CO binding geometries on Cr(110) and related binding states on Fe (100) and Mo(100).

8527 **Cosolvent-induced solubilization of hydrophobic compounds into water.** Banerjee, S.; Yalkowsky, S.H. (Brookhaven National Lab., Upton, NY (USA)). *Analytical Chemistry;* **60**: No. 19, 2153-2155(1 Oct 1988). Contract AC02-76CH00016.

The solubilization of toluene into water by propylene glycol and methanol was measured by a novel liquid chromatographic procedure. The relationship between solubilization and cosolvent content is linear up to 10-20 vol % of cosolvent, beyond which conventional logarithmic behavior is observed. The point of departure from linearity is believed to signal the onset of interaction between the extended hydration shells of the cosolvent. For propylene glycol, the volume of this shell is about 500 mL/mol, and the solubility of toluene within the shell is about 1.3 times its solubility in pure water.

8528 **Structure and symmetry of crystalline solid solutions: general revision.** Vaida, M.; Shimon, L.J.W.; Weisinger-Lewin, Y.; Frolow, F.; Lahav, M.; Leiserowitz, L.; McMullan, R.K. *Science (Washington, D.C.);* **241**: 1475-1479(16 Sep 1988). Contract AC02-76CH00016.

Mixed single crystals composed of host and guest organic molecules of similar structure and shapes are shown to comprise sectors with different host-guest distributions and to have symmetries lower than that of the host crystal. These properties are determined by the structure of the guest and the surface structures of the crystal faces through which the guest molecules are occluded. This general concept is illustrated by studies of three mixed crystal systems, (E)-cinnamamide-(E)-2-thienylacrylamide, (E)-cinnamamide-(E)-3-thienylacrylamide, and (S)-asparagine-(S)-aspartic acid, with x-ray and neutron diffraction and solid-state photochemistry. 19 references, 4 figures, 2 tables.

8529 **Method for synthesizing ultrafine powder materials.** Buss, R.J.; Ho, P. (to Dept. of Energy, Washington, DC). US Patent 4,769,064. 6 Sep 1988. Filed date 21 Jan 1988. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a method for synthesizing ultrafine powder material from gaseous reactants, comprising (a) admitting gaseous reactants from which the powder material is formed into a vacuum reaction chamber maintained at a pressure less than atmospheric and at a temperature less than about 400°K, and directing the gaseous reactants through a glow discharge provided in the vacuum reaction chamber to form the ultrafine powder material.

8530 **(N—88-29909) Active sites and roles of solid acid base catalysts.** Iizuka, T. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1988. Transl. into ENGLISH from Kotai San Enki Shokubai no Kasseiten to sono Hataraki, Shokubai 26 (Japan), No. 3, 171-176(1984). (NASA-TT—20333; NAS—1.77:20333). 23p. NTIS, PC A03/MF A01.

A review on both acid and base catalyst with 42 references is presented. Isomerization of butene, H2-D2 exchange reaction, and hydrogenation reactions are discussed.

8531 **High-temperature diffusion, viscosity, and density measurements in n-eicosane.** Rodden, J.B.; Erkey, C.; Akgerman, A. (Dept. of Chemical Engineering, Texas A and M Univ., College Station, (US)). *Journal of Chemical and Engineering Data;* **33**: No. 3, 344-347(Jul 1988).

Taylor dispersion technique is used to measure the infinite dilution diffusion coefficients of eight solutes (H-/sub 2/, CO, CO/sub 2/, n-C/sub 8/H/sub 18/, n-C/sub 10/H/sub 22/, n-C/sub 12/H/sub 26/, n-C/sub 14/H/sub 30/, n-C/sub 16/H/sub 34/) in n-elcosane over the temperature range 100-260 °C at 1.38 MPa pressure. The density and viscosity of n-elcosane were measured at the same conditions as well. It is shown that the rough hard-sphere theory can correctly represent the data.

8532 **Apparent molar heat capacity and other thermodynamic properties of aqueous KCL solutions to high temperatures and pressures.** Pabalan, R.T.; Pitzer, K.S. (Lawrence Berkeley Lab. and Dept. of Chemistry, Univ. of California, Berkeley, CA (US)). *Journal of Chemical and Engineering Data;* **33**: No. 3, 354-362(Jul 1988).

Heat capacities of KCl solutions have been measured from 413 to 573 K at 200 bar over the molality range of 0.05-3.0 mol kg/sup -1/. These were combined with literature data on volumes, heat capacities, enthalpies, and osmotic coefficients up to a temperature of 599 K and a pressure of 500 bar to yield comprehensive equations for the calculation of the thermodynamic properties of KCl(aq) to high temperatures and pressures by using ion-interaction approach of Pitzer.

8533 **Solution thermodynamics of first-row transition elements. 1. Apparent molal volumes of aqueous NiCl/sub 2/, Ni(ClO/sub 4/)/sub 2/, CuCl/sub 2/, and Cu(ClO/sub 4/)/sub 2/ from 15 to 55°C.** Pogue, R.; Atkinson, G. (Dept. of Chemistry, Univ. of Oklahoma, Norman, OK (US)). *Journal of Chemical and Engineering Data;* **33**: No. 3, 370-376(Jul 1988).

The authors have used a flow densimeter to measure the densities of aqueous solutions of NiCl/sub 2/, Ni(ClO/sub /)/sub 2/, CuCl/sub 2/, and Cu(ClO/sub 4/)/sub 2/ at 10°C intervals from 15 to 55°C. Infinite dilution apparent molal volumes are determined at each temperature by using the Redlich-Meyer equation. These values are fitted to the polynomial Phi/sub upsilon/ = a + bt + ct/sup 2/. The Pitzer formalism has been used to fit the volume data over the entire concentration range (0-3.5 m).

8534 **Improved estimation of solubility and partitioning through correction of UNIFAC-derived activity coefficients.** Banerjee, S.; Howard, P.H. (Brookhaven National Lab., Upton, NY (USA)). *Environmental Science and Technology;* **22**: No. 7, 839-841(Jul 1988). Contract AC02-76CH00016.

Octanol-water partition coefficients (K/sub ow/) of 75 compounds ranging over 9 orders of magnitude are correlated by log K/sub ow/ = -0.40 + 0.73 log ($\gamma$/sub W/)/sub U/ -0.39 log ($\gamma_o$)/sub U/ (r = 0.98), where ($\gamma$//sub W/)/sub U/ and ($\gamma_o$)/sub U/ are UNIFAC-derived activity coefficients in water and octanol, respectively. The constants 0.73 and -0.39 are obtained empirically and are intended to compensate for group nonadditivity. Correction factors of similar magnitude are obtained in independent correlations of water solubility with ($\gamma$/sub W/)/sub U/ and of octanol solubility with ($\gamma_o$)/sub U/, thereby confirming the validity of the approach.

**8535 Dynamic light scattering measurements of reverse micelle phases in liquid and supercritical ethane.** Blitz, J.P.; Fulton, J.L.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2707-2710(19 May 1988). Contract AC06-76RL01830.

Dynamic light scattering of sodium bis(2-ethylhexyl) sulfosuccinate (AOT) in liquid and supercritical ethane provides the first direct evidence of reverse micelles in a supercritical fluid (dense gas). Micellar hydrodynamic diameters are only slightly larger in ethane than in liquid isooctane at the same concentrations and temperature, but diffusion coefficients are more than 10 times greater. Measurements of micelle diffusion coefficient and hydrodynamic diameter versus pressure in liquid and supercritical ethane show that density has a strong effect on hydrodynamic size and suggest that micelle clustering may be significant and highly sensitive to pressure. The utility of dynamic light scattering for studying reverse micelle phases in a dense gas is demonstrated.

**8536 High-resolution electron energy loss spectroscopic study of $CO_2$ adsorbed on Re(0001).** Asscher, M.; Kao, C.T.; Somorjai, G.A. (Hebrew Univ., Jerusalem (Israel)). *Journal of Physical Chemistry;* **92**: No. 10, 2711-2714(19 May 1988).

The adsorption geometry and dissociation of $CO_2$ on Re(0001) were studied by high-resolution electron energy loss spectroscopy (HREELS) over the crystal temperature range of 85-150 K. It was found that $CO_2$ adsorbs as an undistorted linear molecule with its axis parallel to the surface up to a crystal temperature of 120 +/- 5 K. It is characterized by vibrational losses that are very similar to the frequencies of the gas-phases molecule. In the temperature range of 120-135 K a fraction of the adsorbed molecules desorb and the rest transform to an intermediate tentatively identified as a bent $CO_2^-$ which dissociates to CO/sub a/ + O/sub a/ at 135 K and above. Similar results are obtained on an oxidized rhenium surface. The effect of post dosing of oxygen on the vibrational losses of CO adsorbed at 300 K was studied as a model for the $CO_2$ fragments on the surface and was found to be negligible.

**8537 Crystal structure of the as-synthesized precursor $(MnAl_9)P_{10}O_{40}$ x $C_6H_{16}N$ to molecular sieve MnAPO-11.** Pluth, J.J.; Smith, J.V.; Richardson, J.W. Jr. (Univ. of Chicago, IL (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2734-2738(19 May 1988).

The crystal structure of the as-synthesized precursor to molecular sieve MnAPO-11 was determined by single-crystal X-ray diffraction: ~ $(Al_9Mn)P_{10}O_{40}$ x $C_6H_{16}N$, M/sub r/ = 2699, orthorhombic, Icm2, a = 13.472 (1) A, b = 18.712 (1) A, c = 8.4431 (3) A, V = 2128.4 (2) $A^3$, Z = 2, D/sub x/ = 2.14 g $cm^{-3}$, $\lambda(Cu\alpha_1)$ = 1.540 50 A, $\mu$ = 86.1 $cm^{-1}$, F(000) = 1398, T ~ 295 K, R = 0.055 for 1027 diffractions. A 4-connected framework, with $PO_4$, tetrahedra alternating with $(Al,Mn)O_4$ tetrahedra, has the topology of net 263 in which there are isolated parallel elliptical channels parallel to c and bounded by 10-rings. Each channel contains one diisopropylamine species per unit cell in one out of four possible positions. The C and N atoms were located with a precision near 0.1 A. All distances from C atoms to framework oxygen atoms are greater than 3.7 A as expected for van der Waals bonding. The N atom lies at 2.8 A from two framework oxygen atoms, and it is proposed by not proven experimentally, that two hydrogens are bonded to the N atom, instead of one hydrogen for un-ionized diisopropylamine. This would be consistent with charge compensation for occupancy of one tetrahedral $Al^{3+}$ site by $Mn^{2+}$.

**8538 Coadsorption of ethylene and potassium on Pt(111). 1. Formation of a $\pi$-bonded state of ethylene.** Windham, R.G.; Bartram, M.E.; Koel, B.E. (Univ. of Colorado, Boulder (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2862-2870(19 May 1988). Contract FG02-86ER13473.

High resolution electron energy spectroscopy (HREELS), temperature-programmed desorption (TPD), and ultraviolet photoelectron spectroscopy (UPS) have been combined to study the effect of preadsorbed potassium on the adsorption of ethylene on the platinum(111) single-crystal surface. Addition of potassium increases the relative amount of reversible ethylene adsorption at 100 K/. Upon coadsorption with potassium, the authors also observe a new low-temperature ethylene desorption state at 150 K, with E/sub d/ = 5-9 kcal $mol^{-1}$, which is about one-half the binding energy of ethylene adsorbed on clean Pt(111). The origin of this new desorption state is the formation of a weakly interacting ethylene species, which is only slightly distorted from the gas-phase hybridization, as determined primarily by vibrational spectroscopy. An explanation is given for these effects in which the increased charge density at the platinum surface due to coadsorbed potassium inhibits the strong sigma-donation of adsorbed ethylene to platinum and greatly reduces the chemisorption bond strength.

**8539 Reverse micelle and microemulsion phases in supercritical fluids.** Fulton, J.L.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2903-2907(19 May 1988). Contract AC06-76RL01830.

The surfactant sodium bis(2-ethylhexyl) sulfosuccinate (AOT) was used to form reverse micelle and microemulsion phases in supercritical ethane and propane for systems consisting of 80-100% alkane by weight. Phase diagrams obtained from view cell studies of microemulsion phases formed in supercritical fluids are reported and shown to be strongly dependent on pressure. The properties of these solutions were also characterized by conductivity, density, and surfactant solubility measurements. The solubility of AOT in ethane and propane over a range of pressures shows behavior typical of solids in supercritical fluids. The maximum water-to-surfactant ratio ($W_0$) increased dramatically in both ethane and propane systems as pressure was increased. At 300 bar and 103°C, the supercritical propane-surfactant system is capable of solubilizing much more water ($W_0$ = 12) than the supercritical ethane-surfactant system ($W_0$ = 4) at 300 bar and 37°C. Some of the important thermodynamic contributions that are likely responsible for this pressure-dependent phase behavior are discussed, and potential applications of this new class of solvents are considered.

**8540 Structural characterization of bismuth molybdates by x-ray absorption spectroscopy and powder neutron diffraction profile analysis.** Antonio, M.R.; Teller, R.G.; Sandstorm, D.R.; Mehicic, M.; Brazdil, J.F. (BP America Research & Development, Cleveland, OH (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2939-2944(19 May 1988).

By use of synchrotron radiation, high-quality X-ray absorption data have been recorded for three bismuth molybdate phases with the general composition $Bi_2O_3$ x $nMoO_3$, for n = 3 ($\alpha$-phase) n = 2 ($\beta$-phase), and n = 1 ($\gamma$-phase). The results of these bismuth $L_3$-edge and molybdenum K-edge X-ray absorption near edge structure (XANES) and extended X-ray absorption fine structure (EXAFS) studies provide structural insights about the local environments of the $Bi^{3+}$ and $Mo^{6+}$ ions. Also, the structure of $\beta$-$Bi_2O_3$ x $2MoO_3$ was investigated by the use of time-of-flight powder neutron diffraction. The profile analysis of the neutron data for $\beta$-bismuth molybdate (monoclinic, $P2_1/n$, a = 11.9515 (4) A, b = 10.7993 (4) A, c = 11.8805 (4) A, $\beta$ = 90.142 (5)°, and Z = 8) revealed that the bismuth and molybdenum cations are present in a fluorite-like sublattice.

**8541 Solvatochromic behavior of binary supercritical fluids: the carbon dioxide/2-propanol system.** Yonker, C.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). *Journal of Physical Chemistry;* **92**: No. 8, 2374-2378(21 Apr 1988).

Dependence of the solvatochromic shift for binary supercritical fluid mixtures as a function of modifier mole fraction, temperature, and pressure is discussed. Carbon dioxide/2-propanol binary fluid mixtures were studied at both subcritical and supercritical conditions. The local composition of the cybotactic region was seen to be enriched in organic cosolvent at low pressures. As the pressure or temperature increased, the local composition of the organic cosolvent decreased. A simple theory is developed to describe the local composition of the fluid in the cybotactic region about the solvatochromic probe molecule.

**8542 NMR studies of simple molecules on metal surfaces.** Wang, P.K.; Ansermet, J.P.; Rudaz, S.L.; Wang, Z.; Shore, S.; Slichter, C.P.; Sinfelt, J.H. *Science (Washington, D.C.);* **234**: 35-41(3 Oct 1986).

In recent years, improvements in the sensitivity of nuclear magnetic resonance have made it possible to detect progressively smaller numbers of nuclei. Experiments and studies previously thought to be impractical can now be undertaken, for example, the study of phenomena at surfaces. Nuclear magnetic resonance has been applied to study simple molecules (carbon monoxide, acetylene, and ethylene) adsorbed on metal surfaces (ruthenium, rhodium, palladium, osmium, iridium, and platinum). The metals, in the form of clusters 10 to 50 Angstroms in diameter, supported on alumina, are typical of real catalysts. The experiments provide information about the bonding of the molecules to the metal, the structures the molecules assume after adsorption, the motion of molecules on the surface, the breakup of molecules induced by heating, and the products of such breakup.

8543 **Carbochlorination of metal oxides using a fused-salt slurry reactor.** Dobbins, M.S. Ames, IA; Iowa State Univ. (1986). 216p. University Microfilms Order No. 87-03,699.

Thesis (Ph. D.).

The carbochlorination of alumina and fly ash slurried with carbon in a NaCl-$AlCl_3$ fused salt using chlorine was investigated at temperatures between 530 and 800°C. The chlorination rates for up to 85g of alumina or 25g of fly ash in 375g of fused salt containing as much as 45g carbon were determined. Alumina chlorination rates ranging from $2.1(10^{-4})$ to $1.7(10^{-3})$ g-moles $min^{-1}$ were observed at temperatures between 530 and 800°C using a carbon loading of 12.86g. Recoveries of 73% $Al_2O_3$, 83% $Fe_2O_3$, 60% $TiO_2$ and 25% $SiO_2$ were obtained by chlorinating fly ash for 1 hr at 750°C in a melt containing 40% $AlCl_3$.

8544 **Rapid growth of potassium dihydrogen phosphate crystals.** Cooper, J.F.; Singleton, M.F. (Lawrence Livermore National Lab., CA (USA)). *Proceedings of the International Conference on Lasers;* 567-574(1984). Contract W-7405-ENG-48.

The authors report the development of a process for high rate (15 mm/d) growth of potassium dihydrogen phosphate single crystals. Correlations for mass transport by convective diffusion (to cones or disks under axially-impinging flow) are applied to published rate data on 3-mm KDP crystals to derive a semi-empirical kinetic equation for (101) growth rate measured in the z direction: g/sub z/ = k/sub g/ exp(-H/sub g//RT)(c/sub s/-c/sub sat)/sup n/, where the coefficients found by linear regression are k/sub g/ = 3493 m/s. H/sub g/ = 41,399 J/mol and n = 2.277; and c/sub s/ and c/sub sat/ are, respectively, the surface and saturation concentrations [kg-KDP/kg-water]. Material properties, transport, and kinetic equations are then solved numerically to predict the dependence of growth rate on temperature, supersaturation, and the ratio of flow rate to a crystal dimension. The model is experimentally verified for 20-25 mm crystals grown at rates of 5-25 mm/d using a turbine to enhance solute flux to the pyramidal faces. The authors conclude that high growth rate of large crystals is possible and scales according to the ratio of characteristic velocity to crystal dimension.

## 4004 Electrochemistry

*REFER ALSO TO CITATION(S) 7230, 8131*

8545 **(ATR—86(9561)-4) Electrochemical reactions of mixed cobalt/nickel oxide hydroxides in alkaline electrolyte.** Zimmerman, A. H.; Johnson, V. E. (Aerospace Corp., El Segundo, CA (USA)). Jul 1987. 35p. NTIS, PC A03/MF A01.

Thin films of mixed cobalt/nickel oxyhydroxides were electrodeposited on platinum substrates. The electrochemical reactions of these materials were characterized as a function of composition and potential in alkaline electrolytes. The materials formed by electrochemical reaction were also characterized structurally from X-ray diffraction powder data. Evidence is presented for several types of materials that are formed as the cobalt levels are increased in the oxyhydroxide. These materials range from solid-solution beta-nickel oxyhydroxide phases when the cobalt content is less than about 10 percent, to several mixed nickel/cobalt phases formed at intermediate cobalt concentrations, and finally above 90 percent cobalt to the doped cobalt oxyhydroxides. Materials formed at intermediate cobalt levels adopt nickel-rich structures below 50 percent cobalt and cobalt-rich structures above 50 percent cobalt. The nickel-rich and the cobalt-rich materials posses the electrochemical activity of nickel oxyhydroxides, although the cobalt-rich structure appears to have a charge storage capacity reduced approximately by a factor of 2.

8546 **(LBL—26066) Data reduction and analysis of the dissolution of copper in chloride solutions.** Hauser, A.K.; Newman, J. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 14p. (CONF-881061—9). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002953/JAW.

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

A mathematical model is presented that calculates the frequency response of a copper rotating disk in chloride solutions accounting for multicomponent diffusion, migration, and convection. The working algorithm uses concentrated-solution theory, incorporating the Stefan-Maxwell transport equations, and accounts for any number of homogeneous and heterogeneous reactions. The electrochemical impedance is analyzed by examining each contribution of the total cell potential and total current. This gives rise to impedance terms typically neglected in other ac-impedance treatments. Additionally, the faradaic impedance of the copper dissolution system is investigated using a perturbation analysis to split the diffusion layer into inner and outer regions so that the salient features of the problem can be examined separately. Specifically, the effect of finite rates of the homogeneous complexing reaction that follows the electrochemical dissolution reaction is explored. Finally, the perturbation analysis provides a basis for enabling the chemical reaction rate constant to be determined from frequency-response data. 10 refs., 5 figs.

## 4005 Photochemistry

*REFER ALSO TO CITATION(S) 8496, 8535*

8547 **(DOE/ER/04380—T3) Formation of fuel via photochemcial electron transfer: Progress report for the period February 1, 1983--January 1, 1986.** Jones, G. II. (Boston Univ., MA (USA). Dept. of Chemistry). 15 Jan 1986. Contract AC02-77ER04380. 26p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002850/JAW.

Photochemical studies which have proceeded in our laboratory during the past three years are documented in this report. In the sections that follow, completed work is summarized according to the appropriate research theme. The themes include (1) development of electron relays for photoredox processes, (2) the photochemistry of charge-transfer complexes or ion-pairs, (3) the electron transfer photoreactions of the high-potential quinone, chloranil, and (4) the photochemical properties of organic dyes bound to polyelectrolytes. A number of items of work in progress are also included in the research proposal which accompanies this document. 7 figs.

8548 **(DOE/ER/13629—2) Photoinduced charge separation by polymer-bound chromophores: Progress report, September 1987--October 1988.** Webber, S.E. (Texas Univ., Austin (USA). Dept. of Chemistry). Oct 1988. Contract FG05-86ER13629. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003057/JAW.

This report briefly describes the following: (1) studies of singlet state quenching of polymers of methacrylic acid containing the following aromatic chromophores: anthracene, 9-ethylanthracene, 9- phenylanthracene, 9,10-diphenylanthracene, and perylene. (2) Water-Soluble Photon Harvesting Polymers: Random and alternating copolymers of 9-vinylphenanthrene and methacrylic acid have been prepared and extensive studies of the photophysics of this system in organic and aqueous solution carried out. (3) Construction of microsecond transient absorption apparatus. 1 fig.

8549 **Photodissociation dynamics of $C_2H_2$ at 193 nm: Vibrational distributions of the CCH radical and the rotational state distribution of the A-italic-tilde(010) state by time-resolved Fourier transform infrared emission.** Fletcher, T.R.; Leone, S.R. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Institute of Standards and Technology, and Department of Chemistry and Biochemistry, University of Colorado, Boulder, Colorado 80309-0440). *Journal of Chemical Physics;* **90**: No. 2, 871-879(15 Jan 1989).

Time-resolved Fourier transform infrared (FTIR) emission is used to study the formation of CCH in the photodissociation of $C_2H_2$ af 193 nm. Excitation of $C_2H_2$ at 193 nm is known to populate the $10\nu_3$ level of the trans—bent electronically excited state of acetylene, which undergoes decomposition. State-resolved infrared emission is obtained from the CCH radicals that are produced. Only vibronic levels which originate or borrow oscillator strength from the low-lying electronically excited state of CCH, A-italic-tilde $^2$Pi, are observed in this study. The relative intensities of these bands are measured and the rotational state distribution for the A-italic-tilde(010) state is obtained. The observed average rotational energy of CCH is $\sim$156 $cm^{-1}$, which is less than the average rotational energy of the acetylene precursor. A kinematic model which can account for a rotational cooling effect in the A-italic-tilde(010) state is described. The model incorporates the angular momentum generated by the impulsive kick due to the release of the H atom and the cooling due to the orbital angular momentum carried away by the tangential velocity of the H atom, which is imparted by the initial $C_2H_2$ rotation.

8550 **Multiphoton ionization study of the photodissociation dynamics of the $S_2$ state of $CH_3ONO$.** Winniczek, J.W.; Dubs, R.L.; Appling, J.R.; McKoy, V.; White, M.G. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **90**: No. 2, 949-963(15 Jan 1989).

Two-color (1+1) REMPI (resonantly enhanced multiphoton ionization) photoelectron spectroscopy is used to probe the NO photofragments produced by the UV photodissociation of methyl nitrite, i.e., $CH_3ONO+h\nu \rightarrow CH_3ONO^*(S_2) \rightarrow CH_3Ox(X)+NO(X, v, J)$. The photofragments are produced in their ground electronic states but with high rotational and translational energy. NO fragment angular distributions, rotational state distributions, and spatial alignment are determined by photoion and photoelectron detection. The initial state alignment is obtained by the CDAD (circularly dichroic angular distribution) technique for the first time. CDAD measurements for rotational levels with $35.5 \leqq J \leqq 46.5$ result in alignment parameters at the classical high-J limit of A-script/sup $(2)/_0 = -0.4$. This alignment is consistent with an "impulsive" dissociation mechanism in which photofragment recoil along the $CH_3O$—NO bond imparts substantial rotational angular momentum to the NO molecule resulting in a high-J state distribution and preferential rotation in the plane of dissociation. These measurements clearly establish the utility of the CDAD method for probing chemical processes in which spatial alignment plays an important role. Photoion angular distributions are used to probe correlations between the $CH_3ONO$ transition dipole moment, NO fragment velocity, and angular momentum. These correlations reveal additional details of the photolysis mechanism.

8551 **Photoionization study of PH: $PH_2$ revisited.** Berkowitz, J.; Cho, H. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois, 60439). *Journal of Chemical Physics;* **90**: No. 1, 1-6(1 Jan 1989).

The photoion yield curve of $PH^+$ (PH) is presented, from threshold to 1040 A. The adiabatic ionization potential of PH is 10.149 +- 0.008 eV. Extensive autoionization structure is observed and analyzed. It is attributed to several Rydberg series, whose mutual convergence limit is 11.852 +- 0.002 eV, and corresponds to the onset of $PH^+$ (a $^4\Sigma^-$). The photoion yield curve of $AsH^+$ (AsH) is juxtaposed, and shown to have a similar pattern. A new photoion yield curve of $PH^+{}_2$ ($PH_2$) is shown, where the source of $PH_2$ is the H+$PH_3$ reaction. The new results corroborate the earlier data (based on the pyrolysis of benzylphosphine) regarding the adiabatic ionization potential of $PH_2$ to form X $^1A_1$, and the presence of broad autoionizing structure. They also display less scatter, and enable one to estimate the onset for a-italic-tilde $^3B_1$ to be about 0.70 eV above X $^1A_1$. From the analogous behavior of the $AsH^+{}_2$ ($AsH_2$) curve, the a $^3B_1$—X $^1A_1$ splitting in $AsH^+{}_2$ is estimated to be 0.58—0.68 eV.

8552 **Time dependence of donor—acceptor electron transfer and back transfer in solid solution.** Lin, Y.; Dorfman, R.C.; Fayer, M.D. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **90**: No. 1, 159-170(1 Jan 1989).

Electron transfer from an optically excited donor to randomly distributed acceptors followed by electron back transfer is treated theoretically for donors and acceptors in a rigid solution. The forward electron transfer process is described in terms of the excited state population probabilityP/sub ex/(t) of the donor molecules, while the electron back transfer from the radical anion to the radical cation is characterized by P/sub ct/(t), the donor cation state population probability. Exact expressions for the ensemble averages <P/sub ex/(t)> and <P/sub ct/(t)> are derived. Numerical calulations are presented for the cation probabilities, the average cation—anion separation distance <R(t)>, and the average cation existence time <tau(R)>, using parameters which characterize the forward and back transfer distance dependent rates. Relationships among <P/sub ex/(t)>, <P/sub ct/(t)> and the intermolecular interaction parameters provide detailed insights into the distance and time dependence of the flow of electron probability in an ensemble of donors and acceptors. The theoretical expressions can be used to calculate experimental observables. In particular, picosecond transient grating experiments are analyzed, and it is shown that by combining grating experiments (or other ground state recovery experiments) with fluorescence experiments it is possible to obtain the intermolecular interaction parameters for both forward and back transfer and a detailed description of the dynamics.

8553 **Chlorophyll a triplet-state ESR in frozen phosphatidylcholine vesicles.** Hiromitsu, I.; Kevan, L. (Univ. of Houston, TX (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2770-2773(19 May 1988).

Photoexcited chlorophyll a (Chla) triplet state in rapidly frozen egg phosphatidylcholine (EPC) vesicles is investigated at 77 K by electron spin resonance (ESR) spectroscopy using light intensity modulation. The electron spin polarization (ESP) intensity is stronger for 0.2 mM Chla than for 1.0 mM Chla. The absolute values of the zero field splitting parameter, D, are 283 (+/-1) x $10^{-4}$ and 276 (+/-2) x $10^{-4}$ $cm^{-1}$, and the average depopulation rates of the triplet state are 0.671 +/- 0.052 and 1.054 +/- 0.036 $ms^{-1}$ for 0.2 mM Chla and 1.0 mM Chla, respectively. This difference can be consistently attributed to faster triplet-state migration between adjacent Chla's at the higher 1.0 mM Chla concentration. A characteristic migration time of 2.6 ms is obtained. The ESP pattern of the Chla triplet state in the frozen EPC vesicles resembles that in polycrystals more than that in glasses. This suggests that the local environment around Chla in the vesicles is more structured than in glasses.

8554 **Photophysical properties of pyrene covalently bound to polyelectrolytes.** Stramel, R.D.; Nguyen, C.; Webber, S.E.; Rodgers, M.A.J. (Univ. of Texas, Austin (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2934-2938(19 May 1988). Contract FG05-86ER13629.

Copolymers of methacrylic acid, acrylic acid, and poly(styrenesulfonate) have been prepared with small mole fractions of 1-vinylpyrene. The fluorescence properties and quenching efficiencies in water have been measured for high and low pH with methylviologen, sulfonated propylmethylviologen, and a neutral zwitterionic viologen. It has been found that static (or contact) quenching plays a significant role. Formation of a pyrene-viologen charge-transfer complex was observed at high and low pH. Charge separation following redox quenching does not occur for the viologens, unlike the analogous vinyldiphenylanthracene polymers. The absence of charge separation is tentatively ascribed to the formation of a relatively tightly bound complex during the quenching event.

## 4006 Radiation Chemistry

*REFER ALSO TO CITATION(S) 7534, 8382*

**8555 (AERE-R—13290) Radiation processing of polymers.** Rudd, H.J. (UKAEA Harwell Lab. Materials Development Div.). Sep 1988. 28p. H.M. Stationery Office, London, price Pound 10.00.

The current uses of ionising radiation (mainly electron beams and gamma rays) as tools in polymer processing are reviewed. The main uses are to initiate polymerisation of monomer, either in a liquid or a solid, to cross-link thermoplastic materials and uncured rubbers and to effect the controlled degradation of polymers and other substances. The effect of radiation on polymers is considered in chapter two and applications in chapter three. New applications for radiation processing are discussed briefly in the concluding chapter. The review includes 54 references. (U.K.).

**8556 (CEA-R—5453) Kinetic study of the radiochemical ageing of polyethylene.** Papet, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); Ecole Nationale Superieure des Arts et Metiers, 75 - Paris (France)). 1988. 84p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756237/JAW.

Various bulk or multilayer low density polyethylene samples were irradiated by cobalt gamma rays (/sup 60/Co) in air and at ambient temperature. The thickness distribution of carbonyl groups concentration displays a sharp inflexion zone at an invariant depth of about 180 $\mu$m for the dose rate under investigation. The oxidation rate is practically zero in the core zone of thicker samples ($\geqq$500 $\mu$m). An investigation by DSC showed that chemicrystallisation process takes places in the oxidized zones, whereas the well known destruction of crystallites predominates in the center of the sample. Experiments at various oxygen pressures were made in order to determine the rate constants for the unperturbed oxidation process. Then, various kinetic models based on Fick's law, for the diffusion controlled oxidation were compared and discussed, showing that any explanation involving a variation of the permeability cannot be invoked. On this basis, explanations of the shape of the oxidation profiles are proposed, leading to a mathematical prediction of the thickness of the oxidized layer. Large difference is found near the boundaries between the experimental and theoretical results. Hypotheses are made and discussed to explain this discrepancy. The evolution of mechanical properties, for hdPE during radiochemical ageing is also presented; the influence of the oxidized layer on mechanical properties is shown.

**8557** (INIS-SU—56, pp 32-33) **Water radiolysis by uranium fission fragments in the presence of dispersed metal oxides.** Kalashnikov, N.A.; Kalinnikov, A.A.; Krasnoshtanov, V.F. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

Radiation-chemical transformations in heterogeneous systems catalyst (SiO/sub 2/, Li/sub 2/SiO/sub 3/ or BeO)-U/sub 3/O/sub 8/-water under effect of reactor thermal neutrons (neutron flux density of 5.8x10/sup 9/ or 10/sup 13/ neutr./cm/sup 2/xs) at 400 deg C temperature are investigated. Radiolytic hydrogen and oxygen are analyzed chromatographically . The dependence of radiolytic gas yield on water vapor density is studied. The G(H/sub 2/)-water vapor density dependence curve indicates the possibility of existence of two independent processes of water decomposition in different vapor density ranges. 1 fig.

**8558** (INIS-SU—56, pp 34-36) **Thermoradiation decomposition of water vapor in the presence of Fe/sub 2/O/sub 3/ .** Rustamov, V.R.; Bugaenko, L.T.; Kerimov, V.K.; Akhundova, Sh.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

Water thermoradiolysis in the presence of $\alpha$-Fe/sub 2/O/sub 3/ is studied at different temperatures. The thermograms and IR-spectra of $\alpha$-Fe/sub 2/O/sub 3/ specimens irradiated in water vapors and those of FeO for comparison are taken. The dose rate was 2x10/sup 16/ eV/gxs. The dose dependences of hydrogen accumulation at different irradiation temperatures (350-400 deg C) are presented. In the given temperature range the Arrhenius dependence is satisfactorily true at activation energy of 50+-10 kcal/mol. The mechanism of studied catalytical processes is given. 5 refs.; 3 figs.

**8559** (INIS-SU—56, pp 36-37) **Thermoradiation reduction of CO/sub 2/ in the presence of converting admixtures.** Kurbanov, M.A.; Rustamov, V.R.; Mamedov, Kh.F.; Iskenderova, Z.I. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The temperature effect on CO/sub 2/ radiolysis in the presence of hydrogen and methane is studied. The experiments were conducted under static conditions under effect of $\gamma$-radiation. Starting from the value 150 at 500 deg C G(CO) increases up to {similar←to}2.5x10/sup 3/ molec./100 eV at 700 deg C for the mixture CO/sub 2/-10% H/sub 2/. At low temperatures ($\leqq$400 deg C) radiation yields are 5-8 molec./100 eV, indicating suppression of reverse CO oxidation in the presence of hydrogen. In the 500-700 deg C temperature range CO formation proceeds according to the chain mechanism. In the system CO/sub 2/-3% CH/sub 4/ at low temperatures methane plays the role of an acceptor of active particles of CO/sub 2/ radiolysis and G(CO) is about 7-9 molec./100 eV. At 700 deg C radiation yields without thermal contribution are 7 and 220 molec./100 eV for H/sub 2/ and CO, respectively. The high G(CO) value indicates that there is a chain mechanism of its formation. 4 refs.; 4 figs.

**8560** (INIS-SU—56, pp 41-43) **Radiation thermocatalytic processes of hydrogen production from water.** Garibov, A.A.; Gezalov, Kh.B.; Velibekova, G.Z.; Agaev, T.N.; Ramazanova, M.Kh.; Dzhafarov, Ya.D. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The results of studies of radiation-thermocatalytic water decomposition in the 673-773 K temperature range in the presence of BeO and titanium Y-type zeolite are presented. It is found that radiation-thermocatalytic processes of hydrogen production from water are characterized by a lower activation energy (55.4 kJ/mole) as compared with thermocatalytic processes (88.4 kJ/mole). The radiation-thermocatalytic process rate in the presence of oxide systems is not an additive sum of rates of radiation-catalytic (at 296-300 K) and thermocatalytic processes of water decomposition. On the basis of obtained results the conclusion is made that during radiation-catalytic decomposition of water in a heterogeneous system BeO + H/sub 2/O the main contribution into this process is made by excitons, radiation-chemical yields of excitons and non-equilibrium charge-carriers are 4.4-4.5 excitons per 100 eV and 3.0-3.2 pairs per 100 eV, respectively. 8 refs.; 1 fig.

**8561** (INIS-SU—56, pp 43-44) **Experimental investigation of hydrogen sulfide radiolysis.** Grishin, S.P.; Kalinnikov, A.A.; Krasnoshtanov, V.F.; Skobkin, V.S.; Tikhonov, G.I. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The ways of optimization of radiation-thermocatalytic decomposition of hydrogen sulfide are studied. The Al/sub 2/O/sub 3/ powder is used as a catalyst, temperature is about 200 deg C, $\gamma$-radiation dose is 0.5 Mrad. The dependences of gaseous hydrogen yield on H/sub 2/S density for cases of thermoradiolysis (250 deg C), thermocatalytic radiolysis (200 deg C), catalytic radiolysis (25 deg C) are studied. All of them are of linear character. The maximum yields are obtained at H/sub 2/S densities, the highest of the studied ones. The catalytic effect is mostly noticeable at density of

50 mg/cm/sup 3/ and higher. It is noted that the decomposition efficiency can be probably improved by increasing temperature. 1 fig.

8562 (INIS-SU—56, pp 48-50) **Calculation of stationary concentrations of CO/sub 2/ radiolysis products by fission fragments.** Komissarova, V.S.; Krasnoshtanov, V.F.; Khodulev, L.B. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

Parameters of radiolysis of dense carbon dioxide by nuclear fission fragments are calculated. Stationary concentrations of the radiolysis products were calculated by the VETCHINA program. The conclusion was made that in a dense gas the energy release locality and low volumetric density of tracks caused independent processes in some tracks and led to the fact that the stationary concentrations did not depend on the dose rate. The "track" effect realization resulted in improvement of the radiolysis effectiveness and increase of stationary concentrations. 6 refs.; 2 figs.

8563 (INIS-SU—56, pp 37-39) **Gas fuel formation in thermoradiation transformation of masout and pit coal.** Mustafaev, I.I.; Yakubov, K.M.; Mamedov, F.A.; Gulieva, N.K.; Makhmudov, O.M. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; no.2.

In Atomic-hydrogen power and technology. Scientific-technical collection.

The results of study on thermoradiation decomposition and gasification of masout and pit coal under static conditions at absorbed γ-radiation dose of 0-50 kGy, temperature of 20-500 deg C and water vapor pressure of 0.01-0.5 MPa are presented. It is shown that temperature elevation from 20 to 500 deg C results in the increase of radiation-chemical yields in thermoradiation decomposition of masout as follows: from G/sup 0/(H/sub 2/)=0.5, G/sup 0/(CO) =0.009, G/sup 0/(CH/sub 4/)=0.034 molec./100 eV to G(H/sub 2/)=28.3, G(CO)=7.5, G(CH/sub 4/)=286.5. In case of pit coal radiolysis at the process temperature elevation from 20 to 500 deg C radiation-chemical gas yields increase from G/sup 0/(H/sub 2/)=0.023, G/sup 0/(CO)=0.012, G/sup 0/(CH/sub 4/)=0.0034 molec./100 eV to G(H/sub 2/)=37.4, G(CO)=61.5, G(CH/sub 4/)=65.3 molec./100 eV. The increase of gas yields from masout and pit coal in the presence of water vapor indicates that in this case during H/sub 2/, CO, CH/sub 4/ formation the role of intermediate products of water radiolysis becomes important. It results from the temperature dependence of radiation-chemical gas yields that at temperatures ≧400 deg C gases are formed according to the chain mechanism. 3 refs.; 3 figs.

8564 **(INIS-SU—56) Atomic-hydrogen power and technology. Scientific-technical collection.** Legasov, V.A. (eds.). (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 75p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780041/JAW.

Voprosy atomnoj nauki i tekhniki.; No. 2.

Individual papers are processed separately.

8565 **(JAERI-M—88-135) Graft-copolymerization onto carbon black.** Nakase, Yoshiaki; Nishii, Masanobu; Kijima, Toshiyuki; Kato, Hiroshi. (Japan Atomic Energy Research Inst., Neyagawa, Osaka. Osaka Lab. for Radiation Chemistry). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 63p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756058/JAW.

Radiation-induced graft copolymerization of vinyl monomer onto carbon black was performed. During the γ-ray- and electron beam-induced polymerization (In-source), or the electron beam post-polymerization, the graft-copolymerization behavior was affected by the kinds of both carbon blacks and monomers, i.e. the smaller the size of carbon black particles, the higher the apparent grafted fraction. Homopolymer in the grafted carbon black samples was washed out by the solvent of the polymer, and the extracted polymer seemed to be dimer or trimer of the used monomer. In the case of the post-polymerization with the pre-irradiation doses of 50 Mrad, homopolymer was hardly observed. The polymer sheets of plastics or rubbers with grafted carbon black had an electrical conductivity unalterable considerably by the heating cycles. The particles of grafted carbon black in the sheet might be kept much more at the surface layer within 100 nm depth than at the inner layer.

8566 **(RCM—01488) Investigations on radiolytic decomposition of radioactive waste solution. Final report.** Heusinger, H.; Dautzenberg, D. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755979/JAW.

The γ-radiolytic induced recombination between H/sub 2/ und O/sub 2/ were investigated varying different parameters. (H/sub 2/+2O/sub 2/+7N/sub 2/)-mixtures (in opposite to (H/sub 2/+9O/sub 2/)-mixtures), irradiated in big (S/V ≦0,6 cm/sup -1/), SiCl/sub 4/-desactivated glass-vessels, show an induction period followed by an autocatalytic accelerated reaction (up to G(-H/sub 2/) ≦35 000 were observed) that could cause an ignition. Explosion limits of H/sub 2/-O/sub 2/-mixtures containing water vapour were influenced by γ-irradiation. Water free mixtures did not show this effect. With the aid of kinetic modell computations one can simulate thermal induced explosion limits: Shifts of the normal explosion limits of electrolytic gas are not to be expected in HAWC containers. Increased G(-H/sub 2/)-values can be simulated by taking into account irradiation born radicals. (orig.) With 12 refs., 2 tabs., 17 figs.

8567 **Time resolved luminescence spectroscopy of alkaline earth oxides after pulsed electron beam irradiation. II. Spectra and thresholds of MgO.** Grant, J.L.; Cooper, R.; Zeglinski, P.; Boas, J.F. (Department of Physical Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia). *Journal of Chemical Physics;* **90**: No. 2, 807-812(15 Jan 1989).

Time-resolved luminescence spectroscopy has been used to study the emissions occurring in MgO in the time range 100 ns to 100 μs after irradiation with nanosecond duration pulses of electrons of energy between 0.2 and 3.0 MeV. An emission at ~380 nm with a threshold energy of 0.28 +- 0.01 MeV is attributed to processes resulting from the displacement of oxygen anions and the formation of $F^+$ centers. An emission at ~240 nm is attributed to processes resulting from the displacement of magnesium cations, with a threshold energy of 0.32 +- 0.01 MeV. An emission at ~470 nm at an electron energy of 3.0 MeV is attributed to processes resulting from the formation of aggregates of $F^+$ centers, such as the F/sup 2+/$_2$ center. Displacement energies of 49 +- 2 and 38 +- 2 eV were estimated for oxygen anions and magnesium cations, respectively.

8568 **Hall mobility of excess electrons in 2,2-dimethylbutane, 2,2,4-trimethylpentane, and 2,2,4,4,-tetramethylpentane.** Itoh, K.; Munoz, R.C.; Holroyd, R.A. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **90**: No. 2, 1128-1132(15 Jan 1989).

The Hall mobility (μ/sub H/) of excess electrons was measured in liquid 2,2-dimethylbutane (22DMB), 2,2,4-trimethylpentane (224TMP), and 2,2,4,4-tetramethylpentane (2244TMP) at temperatures from 20 to 160 °C. Drift mobilities μ/sub D/ were also measured over this temperature range. At 20 °C the observed values of μ/sub H/ for 22DMB, 224TMP, and 2244TMP are 12, 22, and 32 $cm^2/V$ s, respectively. In all three liquids μ/sub H/ increases with temperature. The comparison of μ/sub H/ and μ/sub D/ indicates that electron traps are absent in 22DMB and 2244TMP. In contrast, in 224TMP μ/sub H/ is about 3.5 times μ/sub D/ at 18 °C. Thus, in this liquid, traps are present and the concentration of traps is about one per thousand solvent molecules. The Hall mobility results are in reasonable accord with the expectations of the deformation potential model and support the concept of scattering of electrons in the conduction band due to density fluctuations.

**8569 Detection of gaseous products in the radiolysis of aqueous solutions.** LaVerne, J.A. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 10, 2808-2809(19 May 1988).

A new technique for the direct determination of radiolytically produced gaseous products is discussed. The method consists of continuously bubbling a gas through a sample cell and monitoring the effluent with a mass spectrometer. It has been applied to the determination of $H_2$ and $CO_2$ produced in various aqueous solutions irradiated with $^{60}Co$ $\gamma$ radiation. The yield of $H_2$ is found to be 0.51 molecules/100 eV in aerated ferrous sulfate solutions and in deaerated KBr solutions. The effect of saturating the ferrous sulfate solution with oxygen or addition of $KNO_2$ to the KBr solution is the same with a yield of $H_2$ of 0.43 molecules/100 eV. The yield of OH radicals as determined by the production of $CO_2$ in dilute oxygen-saturated formic acid solutions is 2.5 molecules/100 eV.

## 4007 Radiochemistry And Nuclear Chemistry

*REFER ALSO TO CITATION(S) 7450, 8469, 8476, 8501, 8503, 9978, 10435*

**8570 (DOE/ER/40329—2) Research in actinide chemistry: Progress report, March 1, 1988--February 28, 1989.** (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1989. Contract FG05-87ER40329. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003058/JAW.

The following areas of research of actinides are briefly discussed: (1) redox reactions of $NpO_2^{+2}$ and $UO_2^{+2}$, (2) dissociation of Sm(III) from humic acid, (3) complexation studies on Am-243, Eu(III), Am(III), $NpO_2^+$, $UO_2^{+2}$, and $Nd^{+3}$, (4) solubility of Eu(III), $UO_2^{+2}$ and Th(IV) in sea water, (5) solvent extraction of Am(III), Eu(III), $UO_2^{+2}$ and Th(IV) by TTA and crown ethers, and (6) fluorescence studies of the mixed ligand complexes of Eu NTA + dicarboxylic acids. (CBS)

**8571 (DOE/ER/60649—T1) Development of gamma-emitting receptor-binding radiotracers for imaging the brain and pancreas: Progress report, March 1, 1985--October 1, 1988.** Reba, R.C. (George Washington Univ., Washington, DC (USA). Dept. of Radiology). 1988. Contract FG05-88ER60649. 52p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89003348/JAW.

Our original objectives were to synthesize a radioiodinated derivative of 4IQNB with a partition coefficient 10-fold less than that of 4IQNB, i.e., similar to that of QNB; to characterize the interaction of 4IQNB with the m-AChR isolated from pancreas; and to synthesize a high affinity analogue of QNB radiolabeled with F-18. We have been investigating the uses of our receptor binding radiotracer, 3-quinuclidinyl 4-iodobenzilate (4IQNB), as an imaging agent for the quantitation of muscarinic acetylcholine receptors (m-AChR) in vivo. Three articles have appeared directly related to our work. 58 refs., 74 figs.

**8572 (INIS-mf—11859) Tests and investigations concerning the development of a jet action process for the decontamination of metal components during decomissioning of nuclear facilities, producing no or only little secondary waste. Final report.** Krakowski, A.; Kratz, H.; Moser, T.; Steringer, A. (Kraftanlagen A.G., Heidelberg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1987. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756184/JAW.

Jet action tests with substances of various material categories were undertaken on varnished surfaces and/or on surfaces covered with an oxide film (rust). The obtained surface clean-up efficiency was evaluated according to DIN 55 928. The tests demonstrated that the below substances are suitable: 1. Dry ice (CO/sub 2/ in solid state): suitable for adhesive contamination. 2. Ammonium tartrate: suitable for varnish removal. 3. Coke: suitable for varnish and rust removal, 4. Polyamide, duroplastic: suitable for varnish removal. When using dry ice and plastics, the jetting agent was supercooled with liquid nitrogen in order to increase the hardness and to embrittle the varnish film. In the course of decomtamination tests on varnished samples, decontamination factors (DF) of 100 were obtained with coke and duroplastic, whereas with ammonium tartrate the DV was 20. In case of oxide films, DF 15 was obtained with coke, and DF 8 with duroplastic. (orig.) With 13 refs., 14 tabs., 16 figs. and 47 coloured photos in appendix.

**8573 (IPEN-PUB—177) Synthesis and preparation of lyophilized kit of p-(bis-carboxymethyl) - aminomethyl carboxyamino hippuric acid.** Almeida, M.A.T.M. de; Hamada, E.S.; Muramoto, E.; Colturato, M.T.; Herrerias, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Jul 1988. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705198/JAW.

A renal agent labeled with/sup 99m/Tc and quantitatively secreted by the tubules constitutes an interesting radiopharmaceutical in substitution to /sup 131/I sodium hippurate. To meet this need we have synthetized a radiopharmaceutical studied previously by Chervu et al. The purity was achieved by melting point, infrared spectra and Proton Magnetic Ressonance. Each lyophilized kit contains 10 mg PAHIDA and 0,25 mg stannous chloride; the radiochemical purity and the stability of the/sup 99m/Tc complex have been stablished by ITLC chromatography. Biological studies were perfomed in Wistar rats.

**8574 (IPEN-PUB—179) Pituitary human growth hormone: small-scale purification method and application to radioimmunoassay.** Bartolini, P.; Ribela, M.T.C.P.; Schwarz, I.; Santos, A.J. dos. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705199/JAW.

Human growth hormone (hGH) extracted from pituitary glands is often heterogeneous, presenting, besides the native isohormone - B (IH-B) up to four different isohormones. To obtain more homogeneous preparations, essential for reproduceble radioligand assay results, the original method was modified, on a small scale, and by adding bacteriostatic and enzime inhibiting agents to all buffers (NaN/sub 3/, EDTA, Trasylol) in order to minimize isohormone formation. After 3 to 4 homogeneizations and extractions of the frozen glands (10-20), hGH is precipitated, by 50% ammonium sulphate immediatly purified by Sephadex G 100 molecular sieve chromatography and hGH fractions are lyophilized. The whole process is completed in one week. Using 20 hypophises, 1.3 mg/gland was obtained. Several labellings with 125-I were performed using this purified hGH stored for more than one year. Two labelling techniques were employed: the classical method which uses 50 $\mu$g of Chloramine T and the stoichiometric iodination, which uses limiting amounts of chloramine T. For this preparation only 1.5 $\mu$g Chloramine T were necessary to achieve the desired specific activity.

**8575 (IPEN-PUB—180) Small scale purification of human pituitary lutropin (hLH) for use in radioligand assays.** Schwarz, I.; Morgante, L.; Bartolini, P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705200/JAW.

Human lutropin (hLH) is a relatively unstable protein, which even in lyophilised form tends to dissociate into subunits during long storage periods. Considering the limited disposibilty of human pituitaries, a small-scale extraction method is proposed for radioassays. Starting from 10 and 20 hypophyses after Sephadex G 100 purification, 10 $\mu$g/gland with approximate 10% purity was obtained. After the last purification, hLH recovery was of 1.5 $\mu$g/gland.

**8576 (IPEN-PUB—208) Labeling of - N-Isopropil - p - I-Anphetamine (IMP-/sup 131/I) and its biological distribution in rats.** Barboza, M.F. de; Goncalves, R.S.V.; Muramoto, E. and others. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 13p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705205/JAW.

The described labeling and purification preparation of N-Isopropil-p/sup 131/I-anphetamine (/sup 131/I-IMP) represents a fast and efficient method to obtains a compound that fullfills all crite-

rions of purity for its application 'IN VIVO'. The labeling yield was 68-78% and the radiochemical purity performed by paper chromatography and electrophorese was 97-99%. As demostrated in animal experiments, the cerebral affinity offers a possibility to study brain diseases in clinical studies when the product will be labelled with /sup 123/I.

8577 **(IPNO-DRE—88-13) Contribution to a prospective in radiochemistry.** David, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1988. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756251/JAW.

Basic rodiochemistry of actinides is reviewed in this report. Researches to be developed on metals solid and gaseous compounds, solution chemistry, thermodynamic properties, oxidation degree, chemical species in solution non aqueous media, chemical reaction kinetics and chemistry at the atom scale are reviewed. These studies have an interest from a theoretical point of views on 5 f elements and practical because of heavy element production in the nuclear fuel cycle.

## 4008 Combustion, Pyrolysis, And High-temperature Chemistry

*REFER ALSO TO CITATION(S) 7382, 7535, 7536, 8518, 8519*

8578 **(AD-A—198685/0/XAB) Dynamic combustion studies using advanced optical diagnostics. Volume 1. Experimental studies. Final report, 21 February 1983-20 October 1987.** Ballal, D.R.; Chen, T.H.; Lightman, A.J.; Schmoll, W.J.; Yaney, P.P. (Dayton Univ., OH (USA). Research Inst.). Jul 1988. 231p. (UDR-TR—88-01). NTIS, PC A11/MF A01.

See also Volume 2, AD-A198 025.

Computer models of turbulent mixing and combustion suffer from many limitations, deficiencies, and errors. To evaluate and refine them, an experimental research program was started (a) to develop a combustion test facility and optical diagnostics, (b) to perform turbulent mixing and combustion experiments, and (c) to provide a data base for modeling needs. This final report describes the combustion test facility and the optical instrumentation, namely a Laser Doppler Anemometer (LDA), and a Laser Raman/Rayleigh Spectroscopy (LRS) system. The problem areas, error analysis, and data reproducibility of these optical techniques are discussed.

8579 **(AGARD-CP—422) Combustion and fuels in gas turbine engines.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Jun 1988. 515p. (In several languages). (CONF-8710419—). NTIS, PC A22/MF A01.

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The attention of combustor designers and researchers has focused upon two main factors: the identification of the significance of fuel degradation upon combustion design and performance, and the potential prizes to be gained by the development of better design techniques. The aim of the conference was to review progress made in these areas under four main subject headings: namely, alternative fuels and fuel injection, combustor development, soot and radiation, and the development of mathematical models for the design of gas turbine combustors.

8580 (AGARD-CP—422, pp 16) **Alternative fuel spray behavior.** Asheim, J.P.; Peters, J.E. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The effects of alternative fuels on the combustion characteristics of a liquid fuel sprays were examined. Fuel properties were systematically varied and the effects of these variations on the structure of the spray flames were calculated. In addition, a comparison was made of the differences in two spray flames fueled by the standard NATO F-40 fuel and a proposed alternative fuel, the AGARD Research Fuel. The calculations were performed using a reacting, two phase, two-dimensional flow code which utilizes a Lagrangian calculation of droplet trajectories and an Eulerian approach for the gas phase flow field. Interactions between the drops and the gas phase were accomplished through the particle in cell technique with exchange of mass, momentum and energy between the two phases. A global reaction scheme was used with the reaction rate determined by the minimum of either an Arrhenius rate or mixing rate. Fuel property changes which affect droplet size and volatility were shown to have significant effects on droplet trajectory patterns. However, for the flow field examined, these trajectory changes only moderately modify the fuel vaporization pattern within the spray.

8581 (AGARD-CP—422, pp 14) **Atomization of alternative fuels.** Lefebvre, A.H. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The influence of atomization quality on several key aspects of combustion performance is reviewed. The performance parameters considered include combustion efficiency, lean blowout, and lean lightup, and also the pollutant emissions of carbon monoxide, unburned hydrocarbons, oxides of nitrogen, and smoke. The fuel properties of importance are described and equations are presented for estimating the effects of changes in fuel properties on spray characteristics for the main types of fuel nozzle employed in aero gas turbines, namely plain orifice, pressure swirl, and airblast atomizers. The anticipated effects on atomization of changes from conventional to alternative fuels is discussed.

8582 (AGARD-CP—422, pp 15) **Multiple scattering effects in drop sizing of dense fuel sprays by laser diffraction.** Guelder, O.L. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Practical schemes to correct the effect of multiple scattering in a dense drop field on the measured distribution parameters by laser light scattering based spray sizing techniques are presented. An experimental study, involving multi-modal distributions and drop field which can not be adequately described by single mode two parameter distribution, is described. Data from the experimental program were employed to develop empirical expressions to correct the measured spray parameters at high obscuration levels. Accuracies of the proposed expressions are acceptable for engineering applications, and comparable to the accuracies involved in conversion of light scattering data to drop size information.

8583 (AGARD-CP—422, pp 8) **Influence of operating conditions on the atomization and distribution of fuel by air blast atomizers.** Cao, M.; Eickhoff, H.; Joos, F.; Simon, B. (Technische Univ., Munich (West Germany)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The performance of a gas turbine combustion chamber depends essentially on the distribution of the fuel in the primary zone. Ignition, stability of combustion, wall temperatures, and smoke and pollutant emission are all affected. Maintaining a fixed geometry, the droplet size and spray angle under variation of the air pressure drop at constant temperature were measured using two test liquids in an air blast atomizer system. Correlation equations were provided for both variables. Known correlations were confirmed for the droplet size. The spray angle is pressure related, increasing very rapidly with increasing pressure.

8584 (AGARD-CP—422, pp 10) **Characterizatin of combustion by fuel composition: measurements in a small conventional combustor.** Kretschmer, D.; Odgers, J. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

In a continuing program on the effects of fuel properties on combustion, some 20 pure hydrocarbons and synthesized fuels were tested at atmospheric conditions in a one third scale version of an aircraft type combustor. This combustor used a Simplex type pres-

sure jet atomizer. Each fuel was burned over a range of air-fuel ratios, and at each condition, a full exhaust gas analysis was done, exhaust temperature distribution was measured, as also weak extinction. The results and their implications are discussed.

8585 (AGARD-CP—422, pp 12) **Radiation from soot-containing flames.** Faeth, G.M.; Gore, J.P.; Sivathanu, Y.R. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The thermal radiation properties of turbulent soot containing diffusion flames are considered, treating: scalar structure, excluding soot; soot properties; and turbulence/radiation interactions. The laminar flamelet concept, implying universal correlations of scalar properties as a function of mixture fraction appears to be effective for estimates of scalar structure needed for analysis of flame radiation. Extension of the laminar flamelet concept to soot volume fractions was also encouraging; however, universality is cruder than for gas properties due to effects of finite rate chemistry. Turbulence/radiation interactions were studied by comparing radiation perdictions based on statistical simulation of scalar properties along a radiation path (stochastic analysis) with conventional results using time averaged properties along the path. Stochastic predictions of spectral radiation intensities are found to be 40 to 100 percent higher than mean property predictions in luminous turbulent diffusion flames, suggesting significant effects of turbulence/radiation interactions.

8586 (AGARD-CP—422, pp 12) **Flamelet chemistry modelling of soot formation for radiation.** Moss, J.B.; Stewart, C.D.; Syed, K.J. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The development of generalized models for radiative heat transfer in the gas turbine requires the detailed prediction of the turbulent scalar fields, most notably for temperature, the principal gaseous species and particulate soot. Mixing limited descriptions of the turbulent combustion process have proved quite successful in modeling the effects of heat release on the flow field. However, the chemical aspects of the problem, fuel specific features and the multi component composition, are poorly reproduced. Laminar flamelet modeling currently offers the best prospect for incorporating realistic complex chemistry into the computations. A strategy is described to extend laminar flamelet modeling of turbulent non-premixed hydrocarbon combustion to include a simplified mechanism for soot formation. In the abscence of a widely applicable multistep kinetic mechanism the formation rate must be inferred from detailed measurement but comparatively comprehensive flow field modeling is necessary to distinguish fluid mechanic and chemical kinetic effects and hence interpret the observations in model terms.

8587 (AGARD-CP—422, pp 14) **Rates of formation of soot from hydrocarbon flames and its destruction.** Mullins, J.; Simmons, B.; Williams, A. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The equations that were proposed in the literature to describe the rate of soot formation in hydrocarbon flames are surveyed. Recent work using a shock tube to measure soot formation rates is outlined and the correlation equation proposed compared with that of other workers. Data on the rate of combustion of soot particles are also outlined and combined with recent measurements to give an overall soot oxidation rate expression. The two equations are combined to give an expression suitable to describe soot formation and burn out for gas turbines and tested to a limited degree.

8588 (AGARD-CP—422, pp 11) **Influence of pressure on soot formation.** Wagner, H.GG. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The influence of pressure on soot formation was investigated for pyrolysis, premixed flames, and diffusion flames. Detailed kinetic studies are available for the first two. It is shown that the essential steps: particle inception, induction time (tau), coagulation, and surface growth remain similar for different pressures, also the influence of temperature on the maximum amount of soot formed. Tau for pyrolysis depends on the carbon density, strongly on temperature, and only slightly on pressure. The coagulation rate constant decreases slightly towards higher pressures. The amount (f sub v) of soot formed per cubic cm for a given fuel-air mixture increases with pressure P like P sup n, n was found for C(sub 2)H(sub 4)-air up to 3, for other fuels near one, it depends on pressure. Larger (f sub v) means larger soot particles, larger radiation losses and longer oxidation time at a given temperature and therefore higher chance for smoke emission.

8589 (AGARD-CP—422, pp 11) **Three-dimensional combustor predictors: a comparison of equilibrium and laminar flamelet chemistry models.** McGuirk, J.J. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Numerical calculations are reported for the three-dimensional reacting flow inside a can-type combustor geometry. Several flow features found in current combustor designs are included, a swirl driven primary zone and a single row of radially inward dilution air jets. The particular aspect of the mathematical formulation given special attention concerns the mode for the chemical reaction. Alternative descriptions of the instantaneous thermochemistry are adopted which correspond to either full chemical equilibrium or the laminar flamelet approach. In the latter case the flamelet structure is taken over from published calculations of laminar propane-air diffusion flames. All other aspects of the mathematical model such as numerical discretization and solution algorithm, turbulence model and turbulence/chemistry interaction are common in the predictions obtained (the two k-epsilon model and a beta-probability density function (pdf) were used). The results obtained indicate that the predicted flow patterns are essentially the same for both chemistry models, even though differences of almost 100 percent are observed for the density field. The predictions with both models indicate, however, a deficiency in the representation of CO burn out and it is probable this will require an alternative chemistry description. Finally, although the calculations have used an unstrained laminar flame description, predictions of the mean scalar dissipation rate are presented to assess the likelihood of local quenching due to flame stretching.

8590 (AGARD-CP—422, pp 7) **Effect of particle properties on radiative heat transfer.** Kakaras, E.; Founti, M.; Papageorgiou, N. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Radiative heat transfer in combustion chambers is strongly influenced by the presence among the gaseous combustion products of solid particles of various size and chemical composition such as soot, char, and fly-ash. The particle parameters of these products are of great importance for the calculation of radiative heat transfer and insufficient knowledge of their magnitude can often lead to erroneous simplifications. The importance of absorption or scattering phenomena in radiative transfer is also sometimes misinterpreted. It is the aim of this work to provide computational data in order to demonstrate and explain the importance of solid particles, present in the combustion products, on absorption and scattering phenomena occurring in the radiative heat transfer.

8591 (AGARD-CP—422, pp 11) **Modeling the stability of a turbulent premixed flame, downstream from a step by a Lagrangian method.** Giovannini, A. Jun 1988. (In French). NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Calculations are carried out for a backward facing step, by solving numerically the Navier-Stokes equations utilizing a Lagrangian method of singularity type. The combustion of premixed gas is modeled by utilizing the concept of a thin flame separating burning and mixing gases (treated as incompressible). The exothermicity of the reaction is represented with the aid of volumetric sources positioned in front of the flame. The advancement of the later is realized through advection, and normally with the combustion velocity

as a function, not only of the thermodynamic mixing state, but also of the local curve of the front and of the front in its entirety. Thus, the combustion aerodynamics can be discussed from the point of view of coherent structures, and the velocities compared with the work of Pitz and Daily with and without chemical reaction.

8592 (AGARD-CP—422, pp 6) **Gaseous premixed flames in non-uniform flows.** Cambray, P.; Deshales, B.; Joulin, G. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A theoretical analysis led to an evolution law for a flame front propagating in a nonuniform flow when the scales of the nonuniformity of the flow are much larger than the flame thickness. This law gives the local burning velocity of the flame front as a function of the flame stretch which can be split in two parts, one accounting for the geometry of the front and the other for the nonuniformity of the flow. In such a law, all the physio-chemical properties of the mixture are lumped in only two scale factors. A theoretical determination of one of these two scale factors (i.e., the so-called Markstein length) is developed. An experimental test of the evolution law is presented in different flame and flow configurations, which leads to experimental values for the two scale factors in the case of lean propane-oxygen-nitrogen mixtures. Finally experimental and theoretical values are compared.

8593 (AGARD-CP—422, pp 9) **Modeling and experimental study of a reactive flow confined with well injection.** Bruel, P.; Champion, M.; Boutouili, M.; Bellet, J.C. Jun 1988. (In French). NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The combustion of premixed fuel injected into a two-dimensional channel is studied numerically and experimentally. In the case of a high injection rate, a model of turbulent combustion with second-order closure for mass and energy transport is developed taking into account prior results obtained in the case of reactive shear flows in a simpler structure. The corresponding code is tested by comparing one part with the exact solution from the case of a Couette flow, and the other part with the experimental results obtained from the velocity fields in a two-dimensional channel.

8594 (AGARD-CP—422, pp 11) **Modelling of CO oxidation in dilution jet flows.** Chleboun, P.V.; Hubbert, K.P.; Sheppard, C.G.W. (Leeds Univ. (England)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Existing equilibrium chemistry and laminar flamelet computer codes are inadequate for calculation of post-flame carbon monoxide burn-up in gas turbine combustion chamber dilution zones. The amount of reaction occurring in such zones is small, but significant in terms of CO emissions, especially under low power conditions. A method was developed, based on a small departure from equilibrium concept, which shows promise in modeling dilution zone carbon monoxide oxidation rate. The procedure, when incorporated into the Rolls-Royce PACE program, still only requires specification of a one-dimensional probability function and entails just one extra conservation equation. Output data were compared with those measured experimentally in an idealized dilution zone.

8595 (AGARD-CP—422, pp 8) **Influence of the convection on evaporation and combustion of a fuel droplet.** Scherrer, D. Jun 1988. (In several languages). NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A numerical model is presented for the combustion of a droplet in a gaseous flow. The method is based on the integration of the unsteady balance equations in the two phases. It uses a finite volumes implicit scheme. The results for the vaporization law are compared with the empirical law of Ranz-Marshall: a good agreement is found only in the case of pure vaporizaton (without combustion) at a sufficient Reynolds number. The other results are the following: the data of the droplet is decreased by the vaporization; the unsteady effects in the gaseous phase become negligible with convection (except those due to finite rate reaction which are not studied here); and the velocities inside the droplet are not sufficient to neglect the unsteady effects due to heat tranfer in the liquid phase.

8596 (CANMET—87-5E) **Optical diagnostic system for the measurement of gas temperature and species concentration.** Hughes, P.M.; Parameswaran, T. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1986. 40p. (MICROLOG—88-04567). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $10.25 OTHER COUNTRIES $12.30 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A complete system has been developed for the non-intrusive measurement of temperature and species concentration in a combusting environment. The technique, termed "coherent, anti-Stokes Raman spectroscopy" (CARS) uses two high-powered, pulse lasers to generate the signal to be measured. The signal so generated emerges from the test section as a laser-like beam and, as such, all of the generated signal is captured for analysis. The technique has advantages over current measurement techniques in that the measurement does not disturb the flame and is frozen in time, the sample volume is small, and the quality and type of measurement taken is more useful to the combustion modeller. This report discusses the theoretical basis for such a technique and some of the practical considerations involved in the optical arrangement. To apply this technique successfully, it was necessary to develop sophisticated software and hardware. The incorporation of these and the optics into a CARS system is discussed, together with the theory of its application. 25 refs., 5 figs., 1 tab.

8597 (CONF-8809198—1) **Fluorine as an oxidant in combustion calorimetry.** O'Hare, P.A.G. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003626/JAW.

From 4. Polish conference on calorimetry and thermal analysis; Warsaw, Poland (5 Sep 1988).

Oxygen-bomb calorimetry has been used with some success over the years for the determination of enthalpies of formation $\Delta$/sub f/H/sub m/$^0$ of inorganic compounds. This method, however, has a number of drawbacks, the most significant of which is the formation of complicated and ill-defined oxides as reaction products. Substitution of fluorine for oxygen, as the oxidizing gas, eliminates many of those problems. Because of the aggressive nature of fluorine, it can be used to study even the most refractory of materials, but its disadvantages are that it requires very careful handling and special apparatus. A portion of the present paper will discuss the precautions that must be taken, and the special calorimetric equipment that has been constructed. The main scope of the paper, however, is concerned with our recent results obtained for some high-purity chalcogenides. We have performed measurements on both the crystalline and vitreous forms of $As_2Se_3$. The enthalpies of formation have been deduced from the calorimetric enthalpies of fluorination. The following preliminary results at 298.15 K have been obtained and are compared in the paper with published values: $\Delta$/sub f/H/sub m/$^0$($As_2Se_3$, cr) = -(83.7+-4.5) kJ{center←dot}mol$^{-1}$ and $\Delta$/sub f/H/sub m/$^0$($As_2Se_3$, vit) = -(59.4+-4.3)kJ{center←dot}mol$^{-1}$. The enthalpy of transition is -(24.3+-3.9)kJ{center←dot}mol$^{-1}$, only about 60 per cent of the previous literature value. 27 refs., 2 figs., 6 tabs.

8598 (DOE/ER/13092—T1) **Fundamental droplet combustion characteristics of mixtures and emulsions: Final report.** Avedisian, C.T. (Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). Oct 1988. Contract AC02-83ER13092. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002862/JAW.

A study of the evaporation and burning characteristics of unsupported fuel droplets was carried out. Several experiments were performed to focus on the following aspects of the droplet burning process: (1) mechanisms of disruptive burning, (2) preferential evaporation of droplets which are emulsified fuels, (3) the ab-

sence of buoyancy induced flow around the droplet, and (4) soot formation around a burning droplet. The primary means of data acquisition in all the experiments was photographic. The experiments were designed to focus on a single aspect of droplet burning. For example, the mechanisms of disruptive burning were studied by levitating a field droplet in another immiscible liquid and then inducing a bubble to form within the levitated droplet by lowering the pressure of the field liquid. The mechanisms controlling the dynamics of growth of the internal bubble are considered to be the same as would occur within a burning droplet experiencing microexplosion. An experiment was designed to observe the burning of an unsupported and nearly stationary droplet at low gravity over its entire burning period--from ignition to extinction or burnout. The extended period of burning revealed an extinction-like phenomena for heptane that was characterized by a period near the end of burning during which the droplet diameter remained constant. The data obtained are applicable to models for droplet burning which do not include buoyancy effects.

8599 **(N—88-29997) Optical measurements of soot and temperature profiles in premixed propane-oxygen flames.** Lyons, V.J.; Pagni, P.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 20p. (NASA-TM—101343; E—4363; NAS—1.15:101343; CONF-881120—). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Two laser diagnostic techniques were used to measure soot volume fractions, number densities and soot particle radii in premixed propane/oxygen flat flames. The two techniques used were two wavelength extinction, using 514.5 nm to 632.8 nm and 457.9 nm to 632.8 nm wavelength combinations, and extinction/scattering using 514.5 nm light. The flames wre fuel-rich (equivalence ratios from 2.1 to 2.8) and had cold gas velocities varying from 3.4 to 5.5 cm/s. Measurements were made at various heights above the sintered-bronze, water-cooled flat flame burner with the equivalence ratio and cold gas velocity fixed. Also, measurements were made at a fixed height above the burner and fixed cold gas velocity while varying the equivalence ratio. Both laser techniques are based on the same underlying assumptions of particle size distribution and soot optical properties. Full Mie theory was used to determine the extinction coefficients K sub ext, and the scattering efficiencies, Q sub vv. Temperature measurements in the flames were made using infrared radiometry. Good agreement between the two techniques in terms of soot particle radii, number density and volume fraction was found for intensity ratios (I/I sub o) between 0.1 and 0.8. For intensity ratios higher or lower than this range, the differences in extinction coefficients at the wavelengths chosen for the two-wavelength method are too small to give accurate results for comparing particle radii and number densities. However, when comparing only soot volume fractions, the agreement between the two techniques continued to be good for intensity ratios up to 0.95.

8600 **(N—89-11459) Domain decomposition methods for the parallel computation of reacting flows. Final report.** Keyes, D.E. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1988. 26p. (NASA-CR—181719; ICASE—88-52; NAS—1.26:181719). NTIS, PC A03/MF A01.

Domain decomposition is a natural route to parallel computing for partial differential equation solvers. Subdomains of which the original domain of definition is comprised are assigned to independent processors at the price of periodic coordination between processors to compute global parameters and maintain the requisite degree of continuity of the solution at the subdomain interfaces. In the domain-decomposed solution of steady multidimensional systems of PDEs by finite difference methods using a pseudo-transient version of Newton iteration, the only portion of the computation which generally stands in the way of efficient parallelization is the solution of the large, sparse linear systems arising at each Newton step. For some Jacobian matrices drawn from an actual two-dimensional reacting flow problem, comparisons are made between relaxation-based linear solvers and also preconditioned iterative methods of Conjugate Gradient and Chebyshev type, focusing attention on both iteration count and global inner product count. The generalized minimum residual method with block-ILU preconditioning is judged the best serial method among those considered, and parallel numerical experiments on the Encore Multimax demonstrate for it approximately 10-fold speedup on 16 processors.

8601 **(PB—89-100481/XAB) Heat-of-mixing experiments for liquefied gases. Final report, November 1982-December 1985.** Zollweg, J.A.; Streett, W.B. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). May 1987. 66p. NTIS, PC A04/MF A01.

See also PB—85-183697.

Excess enthalpies were measured for Kr/Xe at 163 K, $N_2/O_2$ at 80K, $CO/CH_4$ at 91.3K, $N_2/CO$ at 83.82K, $Xe/(CH3)_2O$ at 182.3K and $Xe/C_2H_4$ at 162.9K at saturation pressure using the batch mixing calorimeter constructed under the previous contract. In each case, independently measured vapor-liquid equilibrium data were used to correct for the heat effect of vaporization during the mixing process. Modifications were made to the calorimeter to improve its performance during this period. The data obtained on $CO_2/C_2H_6$ at two temperatures were compared with thermodynamic perturbation theory and data for Kr/Xe and $C_2H_6/C_3H_8$ have been found consistent with a van der Waals one-fluid model using appropriate mixing parameters. A new flow calorimeter for use at cryogenic temperatures was designed and partially constructed. It is intended for use between 77 and 400 K and at pressures to 2800 psia (20 MPa).

8602 **(PB—89-103907/XAB) Investigation of NOx formation and removal mechanisms in hydrocarbon-air flames. Annual report, June 1987-June 1988.** Hanson, R.K.; Bowman, C.T. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jul 1988. 17p. NTIS, PC A03/MF A01.

See also PB—88-112750.

In this research program, the kinetics of NOx formation and removal in combustion of gaseous fuels are being investigated. The program addresses uncertainties in reaction mechanism and rate parameters and the coupling of NO formation and removal reactions with the hydrocarbon combustion reactions. Significant progress was made on development of a detailed kinetics model for predicting CH profiles in the pyrolysis of highly dilute $CH_4$/Ar and $C_2H_6$/Ar mixtures. The model was used in the analysis of data from the kinetics experiments described below. Kinetics experiments using a CH laser diagnostic were performed with $C_2H_6$/Ar mixtures alone and with varying amounts of $N_2$ or NO to determine the rates of $CH + N_2$ -> products; and CH + NO -> products. In addition, atomic resonance absorption was applied to detect N atoms and O atoms and laser absorption to detect OH in order to determine the products of reactions. Analysis of the data from these experiments is in progress. Finally, in the absence of a $CH_2$ diagnostic, the authors have attempted to determine the rate of $CH_2 + N_2$ -> HCN + NH indirectly by measuring production of NH using a laser-absorption technique.

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*REFER ALSO TO CITATION(S) 8417*

8603 **(SAND—88-2934) The 8th biennial cube symposium: Abstracts.** (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 138p. (CONF-8811110—Absts.). NTIS, PC A08/MF A01 - OSTI. Order Number DE89004502/JAW.

From 8. biennial CUBE symposium; Albuquerque, NM, United States (16 Nov 1988).

This publication contains the program and topic abstracts of the 8th Biennial Cube Symposium. Topics included in abstract form are: Solid and Structural Mechanics; Software Development; Safeguards Systems, Information Management and Security; Radiation Transport; Electromagnetic Modeling; Computer Graphics; Weapons Systems Engineering; NEW Systems Analysis; Data Acquisition and Analysis Systems; Expert Systems; Image Processing; Systems Modeling; Weapons Effects Analysis; and Computer Aided Engineering. (IF)

8604 **(UCRL—50016-87-2) Technical abstracts for the period July--December 1987.** Goluba, R.W. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004428/JAW.

Twice a year, Mechanical Engineering publishes Technical Abstracts as a reference to the technical reporting generated by Mechanical Engineering. Subjects cover a broad range of technologies within Mechanical Engineering from fabrication to computer-code analysis and development. Please contact the author(s) for additional information on any subject of interest to you. In all cases, abstracts are of source material that has been assigned a Laboratory report number. The primary source of the abstracts is published Laboratory reports: These are the UCRL-15000 and -50000 series formal reports; UCIDs; and UCRL-90000 series reports, which include the full text of articles to be published in a journal and of papers to be presented at a meeting. However, the source of some abstracts is unpublished material: These are the UCRL-90000-ABS (abstract) and UCRL-90000-SUM (summary) categories of material, which are prepared by the authors either for an undocumented verbal presentation, or for submittal as a prospective journal article or meeting paper. Some MISC (miscellaneous) series reports are included as appropriate, Most abstracts have been edited to fit the format of this document. All abstracts are arranged alphabetically by the abstract's first-listed author. Each abstract is identified by a letter/number combination that is used for indexing purposes: The letter matches the surname of the first-listed author, and the number is the sequential order of the abstract within the letter grouping. Three indexes are provided: Key Word, Author, and Report Number.

## 4202 Facilities And Equipment

*REFER ALSO TO CITATION(S) 7337, 7412, 7505, 7725, 7791, 7963, 8011, 8103, 8435, 8735, 8780, 8793, 8879, 8991, 8997, 9100, 10505*

8605 **(AD-A—197372/6/XAB) Physiological strain during exercise-heat stress experienced by soldiers wearing candidate chemical protective fabric systems. Technical report.** Wenger, C.B.; Santee, W.R. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Jun 1988. 54p. (USARIEM-T—16/88). NTIS, PC A04/MF A01.

The heat-stress problem of soldiers working in warm environments wearing chemical protective clothing is well documented. The thermal insulation and low moisture permeability of such clothing severely limit the effectiveness of the body's heat dissipating mechanisms. Several foreign and domestic experimental fabric systems are now available, and the thermal and vapor transfer characteristics of some of these systems have been tested in static configurations. This technical report describes the evaluation of three experimental fabric systems for their effect on thermal strain experienced by soldiers during exercise in the heat.

8606 **(AD-A—197521/8/XAB) R-f SQUID (superconducting quantum interference device) detector for single-ion trapping experiments.** Weisskoff, R.M.; Lafyatis, G.P.; Boyce, K.R.; Cornell, E.A.; Flanagan, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1 May 1988. 7p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 63, No. 9, 4599-4604(1 May 1988).

The authors designed and constructed a novel superconducting detector sensitive enough to detect the axial motion of a single, trapped ion. This detector employs a tuned, superconducting transformer matched to a r-f SQUID (superconducting quantum interference device) to yield an effective current sensitivity of 2.7 x $10^{-15}$ A/the square root of Hz at 160 kHz. To optimize the detection system, the authors used existing small-signal equivalent circuit models, and thus tested these models in a new regime. Details of the superconducting circuitry and of the modifications required to stabilize the commercial SQUID controls at 160 kHz are included. Finally, typical detected signals from trapped ions are presented.

8607 **(AD-A—197703/2/XAB) Physiological responses wearing MOPP-IV after atropine and pralidoxime administration in warm and cool environments.** Kolka, M.A.; Cadarette, B.S. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Apr 1988. 17p. NTIS, PC A03/MF A01.

The effect of cholinolytic and oxime (2 mg atropine + 600 mg pralidoxime) therapy on temperature regulation was evaluated in 8 subjects wearing chemical warfare protective clothing (MOPP-level IV). Subjects were tested in two environments: 35 c, 60% rh and 13 C, 44% rh during very light physical activity (1-2 Met) over a six-hour period. Sweating was suppressed approximately 40% by atropine and pralidoxime, and heart rate increased approximately 30 beats/min with drug treatment. At 13 C, all eight subjects completed 350 minutes of exposure in both drug and control experiments. Rectal temperature (t sub re) averaged 38.24 C in both treatments when subjects terminated their exposure at 35 C. Mean skin temperature averaged 37.42 C for both groups at termination. The treatment of subjects with atropine and pralidoxime when wearing chemical protective clothing does not adversely affect the length of time individuals can remain in a cool environment during very light work. However, the wearing of chemical protective clothing will decrease exposure time significantly (approx. 40%) in both control and drug treated subjects in a warm environment.

8608 **(AD-A—197806/3/XAB) Plasma renin activity and aldosterone: correlations with moderate hypohydration.** Francesconi, R.P.; Szlyk, P.C.; Sils, I.V.; Leva, N.; Hubbard, R.W. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Jun 1988. 29p. NTIS, PC A03/MF A01.

Adult male test subjects were assigned to one of three clothing configurations (Army fatigues, fatigues with chemical-protective garments, and fatigues with protective garments plus protective masks) prior to exercise (level treadmill, 1.11 m/s, 50 min/h, 6h) in a moderate (WBGT=23 C) environment with ad lib water consumption. Antecubital blood samples were taken prior to the start of and subsequent to the completion of exercise and analyzed for fluid-electrolyte regulatory hormones. During all trials with chemical protective garments, plasma renin activity (PRA) and aldosterone levels (PA) were significantly elevated following the exercise protocol while neither was affected during exercise in fatigues only. Individual hypohydration levels during all trials ranged from low to moderate. Levels of PRA were closely correlated with hypohydration as measured by percentage of body weight lost during the 6 h trial. Likewise, PA was also correlated with body weight loss. The authors concluded from this study that PRA and PA responses were exacerbated in moderate environments by the additional heat stress of impermeable garments. Further, the logistical difficulty inherent in delivering fluid through the chemical protective mask reduced voluntary consumption, increased hypohydration, and elicited the greatest elevations in PRA and PA. Finally, even at these modest levels of hypohydration, the intensity of the PRA and PA responses were correlated with hypohydration level.

8609 **(AD-A—197905/3/XAB) Superconductive wideband analog signal correlator with buffered digital output.** Green, J.B.; Anderson, A.C.; Withers, R.S. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1988. 6p. (MS—7491A). NTIS, PC A02/MF A01.

Pub. in SPIE, v879-Sensing, Discrimination, and Signal Processing and Superconducting Materials and Instrumentation, 71-75(1988).

Analog superconductive components were integrated to form a device capable of cross correlation between two wideband analog input signals. Arrays of $Nb/Nb_2O_5/Pb$ tunnel junctions perform the mixing of delayed samples of two frequency-offset analog signals counterpropagating along a niobium-tapped transmission line. The resultant mixer products from the junction array are integrated and stored in a high-Q lumped element L-C resonator tuned to the signal difference frequency. A superconductive tunnel junction imbedded in the resonator circuit is operated as a variable threshold comparator to detect the time-integrated current stored in the resonator. Results are presented showing the correlation properties of such an individual correlator cell, together with the design and performance of a 4-junction-logic (4JL)-based digital address

encoder to be used in a multichannel correlator device. The authors also discuss the important design issues as they relate to analog signal processing.

8610 **(AD-A—198155/4/XAB) Opening-switch research on a plasma focus. VI. Final report, 30 September 1986-29 September 1987.** Gerdin, G.A. (Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering). 26 Feb 1988. 140p. NTIS, PC A07/MF A01.

The utility of the plasma focus as an opening switch was analyzed on the basis of the author's previous experimental observations and those on other Mather-type devices. A load resistor was recently included in the opening-switch circuit model and the analysis indicates that the typical pinch resistances measured (approx .1 ohm) are too small to drive typical load resistances encountered in pulsed power (approx 1 ohm) in terms of % energy transferred (<2%) and the time required for the transfer (> or = 200 ns). A scaling law for pinch stability was derived, which is consistent with the author's data and that from several other experimental devices; this model predicts that a plasma focus could be designed to permit longer energy transfer times by increasing the anode radius.

8611 **(AD-A—198480/6/XAB) Transport and junction physics of semiconductor-metal eutectic composites. Final report, 1 April 1986-31 March 1988.** Ditchek, B.; Gustafson, J. (GTE Labs., Inc., Waltham, MA (USA)). Jun 1988. 104p. NTIS, PC A06/MF A01.

An investigation of the transport and junction physics of Si-$TaSi_2$ semiconductor-metal eutectic composites has demonstrated the potential use of this class of materials in highpower switching. Following the development of single-crystal-matrix Si-$TaSi_2$ crystals, eutectic diodes utilizing the in-situ junctions were fabricated and analyzed using current-voltage, capacitance-voltage, and electron-beam-induced current techniques. Studies demonstrated nearly ideal diode behavior, a Schottky-barrier height of 0.62 eV, and a means of measuring the extent of the depletion zones and the carrier concentration of the semiconductor matrix. An analysis based on a comparison of the EBIC-determined carrier concentration with the Hall carrier concentration resulted in a measure of the effect of the depletion zones on composite resistivity. Building on the foundation provided by this analysis, the first eutectic-composite transistors were demonstrated. These devices confirmed that current flow can be controlled by pinching off Si channels between $TaSi_2$ rods. Furthermore, testing at high voltages indicated that the eutectic devices are resistant to avalanche breakdown. Devices were built that block 600 V, three times the value for a conventional planar device in a wafer of the same carrier concentration.

8612 **(AD-A—198968/0/XAB) Evaluation of transparent polymers for chemically hardened army systems. Final report.** Vanselow, J.J.; Hsieh, A.J. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Jul 1988. 24p. (MTL-TR—88-24). NTIS, PC A03/MF A01.

Polymers being considered for use as transparent armor are evaluated for resistance to degradation in a chemical environment and consequently for their ability to be decontaminated. Immersion of these materials in organic liquids chosen as simulants for the CW agents, as well as the decontaminant DS2, is performed as a preliminary screening. These materials include polycarbonate (PC), four forms of polymethyl methacrylate (PMMA), a developmental polyurethane, and polyetherimide (PEI). Environmental-stress crazing and cracking (ESC) tests are also used to determine the chemical resistance of PC. The use of linear elastic fracture mechanics (LEFM) for determining the fracture toughness of several of these transparent polymers is illustrated. The development of a crack-propagation study based on LEFM is demonstrated with PEI. Ballistic testing is also reported on to further characterize the mechanical properties of these materials.

8613 **(CONF-881120—18) Computer simulation as an aid in interpreting vibration signatures.** Clapp, N.E.; Damiano, B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004174/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Predictive maintenance based on spectral analysis of vibration data is commonly used in industry. The success of this technique often depends on trending resonant frequencies and the signatures of anomalies using a relatively large volume of data collected under known conditions. The amount of data necessary for accurate diagnostics is large because the data set must contain the anomalies being diagnosed, as well as enough information to extract the anomalies' effect(s) from the data set. This paper describes a method which may extend the applicability of predictive maintenance methods based on vibration data to situations in which only sparse data are available for trending or the actual machine condition during data collection is unknown. The method uses a mathematical simulation of machine response to applied forces as a diagnostic tool which, when diagnostics are performed, can supplement previous measurements. This approach consists of modeling both the machine response and the forces generated by machine degradation. It may be possible to diagnose vibration anomalies by comparing measured and simulated vibration signatures. 3 refs., 6 figs.

8614 **(CONF-881120—19) Advantages of high-temperature superconductivity in large-scale applications.** Hull, J.R.; Berry, G.F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 25p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003662/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

The discovery of superconducting materials with critical temperatures above the boiling point of nitrogen is expected to lead to increased viability of many existing large-scale applications of superconductivity and to the enabling of many new applications. Whereas the readily available terrestrial supply of liquid helium is insufficient for widespread use of superconductivity, the supply of nitrogen is ample. Operation at liquid nitrogen temperatures improves the refrigeration factor by about 25, allowing smaller sized devices to be feasible. The larger heat capacity improves stability of operation. 21 refs., 1 fig.

8615 **(CONF-890153—1) HERMIES-III: A step toward autonomous mobility, manipulation and perception.** Weisbin, C.R.; Burks, B.L.; Einstein, J.R.; Feezell, R.R.; Manges, W.W.; Thompson, D.H. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004932/JAW.

From NASA conference on space telerobotics; Pasadena, CA, USA (31 Jan 1989).

HERMIES-III is an autonomous robot comprised of a seven degree-of-freedom (DOF) manipulator designed for human scale tasks, a laser range finder, a sonar array, an omnidirectional wheel-driven chassis, multiple cameras, and a dual computer system containing a 16-node hypercube expandable to 128 nodes. The current experimental program involves performance of human-scale tasks (e.g., valve manipulation, use of tools), integration of a dexterous manipulator and platform motion in geometrically complex environments, and effective use of multiple cooperating robots (HERMIES-IIB and HERMIES-III). The environment in which the robots operate has been designed to include multiple valves, pipes, meters, obstacles on the floor, valves occluded from view, and multiple paths of differing navigation complexity. The ongoing research program supports the development of autonomous capability for HERMIES-IIB and III to perform complex navigation and manipulation under time constraints, while dealing with imprecise sensory information. 10 refs., 4 figs.

8616 **(CONF-8810213—1) Nitride and carbide coatings for high speed steel cutting tools.** Fenske, G.R. (Argonne National Lab., IL (USA). Materials and Components Technology Div.). 1988. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003623/JAW.

From Tribology conference; Baltimore, MD, USA (16 Oct 1988).

Hard nitride and carbide coatings of Ti, Zr, and Hf were deposited by physical vapor deposition processes on high-speed steel cutting tools to determine their effectiveness in improving the wear properties of the inserts and increasing cutting-tool performance. A collaborative research program involving industrial, university, and

government laboratories was established to develop coating processes and tool wear models, to characterize the coating properties and the effect of process parameters on the coating properties, and to evaluate the cutting performance of coated inserts. Two coating processes were selected for investigation: high-rate reactive sputtering and activated reactive evaporation. The lifetimes of coated inserts were extended 2 to 10 times, depending on the coating composition and process. Analysis of the wear modes that occurred during the cutting tests indicated that the coatings failed by fracture after plastic deformation of the underlying substrate occurred as a result of substrate softening at the high cutting speeds. 14 refs., 9 figs., 1 tab.

8617 **(CRIE-U—87064) Investigation of the rapid estimation method of alkali aggregate reaction of concrete by the autoclave curing.** Nakano, Takehiro; Onuma, Hiroshi; Kanazu, Tsutomu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755727/JAW.

Rapid estimation of alkali aggregate reaction and measures to cope with the situation are important matters to prevents the degradation of the concrete structure. The rapid estimation method was investigated, in which concrete specimens were tested by accelerated method using the autoclave steam curing instrument, with reference to previous study on mortar specimens. The aggregate samples used in the study are as follows; one kind of sample containing potential reactive mineral in large quantities, three samples with medium content of that ones, and one harmless sample. When the quantity of total alkalis in cement was 1.5 percent, the expansive property of concrete after the autoclave curing test was sufficiently large. And when the expansive strain of 0.1 percent was adopted as a provisional critical value at the autoclave curing test, it was clarified that aggregates could be divided into reactivity and non-reactivity. (4 figs, 12 tabs, 24 photos, 6 refs)

8618 **(DNV/C—84-CGY-015) Assessment of non-destructive technology required for inspecting offshore structures.** (Det Norske Veritas (Canada) Ltd.). 1984. 188p. (MICROLOG—88-04575). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report contains a critical review and assessment of the methods used for non-destructive evaluation (NDE) of offshore structures. The capabilities of Canadian and foreign organizations to perform offshore inspection are also evaluated. The report also reviews NDE equipment together with their specificaitons and manufacturing. Experience has shown that the main defects encountered in inspection are cracks and corrosion, and methods currently used in the type of inspection most critical for meeting the principal objectives of NDE are: close visual inspection by divers; radiography; ultrasonic testing; and magnetic particle inspection. NDE methods based on ultrasonics have been found in general to be suitable for underwater use and recommended for the examinations of internal defects and wall-thickness measurements where the velocity of sound propagation through the material under examination is known. Various methods based on the principles of electromagnetism have also proved useful in the underwater detection of surface defects. The survey shows that the common practice in equipment development is the modification of what has been successfully used above water to make it operational underwater. The review of NDE techniques under development indicates that emphasis will increasingly be on automation and remote control of equipment, as well as on real-time signal processing and the optimization of the operations involved in offshore NDE. Instrumented monitoring of offshore structures is also discussed, and recommendations are made for transfer of NDE technology to Canada. 139 refs., 31 figs., 14 tabs.

8619 **(DOE/CE/15248—T1) 0.3K closed cycle refrigerator system: Final report.** Swartz, E.T.; DuBois, P.B.; Bazaj, D.K.; Swartz, D.L. (RMC-Cryosystems, Tucson, AZ (USA)). 12 Dec 1988. Contract FG01-86CE15248. 33p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004421/JAW.

We have developed and built a $^3$He cryogenic system capable of cooling to 0.5 K without the need of consumable cryogens. This cryogenic system can be controlled at any temperature between 0.5 K and room temperature, and could be made to be entirely computer controlled. Freedom from consumable cryogens allows relatively inexpensive and efficient access to sub-Kelvin temperatures in remote areas. For many types of measurements at cryogenic temperatures, the use of consumable cryogens is complicated and inefficient. 9 figs.

8620 **(DOE/OR/00033—T406) Application of thermodynamic approach to pneumatic transport at pipe orientations above the horizontal.** Zaltash, A. (Oak Ridge Associated Universities, Inc., TN (USA); Pittsburgh Univ., PA (USA). School of Engineering). 1987. Contract AC05-76OR00033. 342p. NTIS, PC A15/MF A01. Order Number DE88015639/JAW.

Application of thermodynamic analogy to pneumatic transport in 0.0266 m and 0.0504 m systems held at various angles of inclination was investigated. Particles used in these systems included glass particles of 67 μm, 450 μm, and 900 μm weight mean diameter as well as iron ore of 400 μm weight mean diameter. An equation of state similar to the van der Waals has been suggested for these systems. Measurements in these experimental set-ups included pressure drops, particle velocities, and solids mass flow rates in both the upper and lower halves of the pipe. These measurements were used to describe the phase behavior of the systems studied. It was found that the van der Waals analog is capable of describing the phase behavior of these systems. A method has been proposed to estimate the parameters of the van der Waals analog equation. The incorporation of dimensionless pressure drop into the analysis has been attempted by the use of energy functions in thermodynamics. The effect of inclination angle, pipe diameter, and particle characteristics on basic flow parameters were studied. The ratio of solids flow in the top half to that of the bottom half of the pipe showed that the concentration gradient is influenced by particle characteristics, and by the pipe diameter and orientation. Glass test section was used in these systems for visual observations of the flow patterns. 53 refs., 176 figs., 52 tabs.

8621 **(DOE/SF/15934—T1) Design studies for cryoresistive and superconductive magnetic energy storage for space use: Final report, September 1985--October 1987.** Boom, R.W.; Eyssa, Y.M.; Huang, X.; Abdelsalam, M.K.; Hamdi, M.; Hilal, M.; El-Marazki, L.O.; McIntosh, G.E.; Waynert, J.; Crabb, T.; Wiederholt, H.; Jacobs, M. (Wisconsin Univ., Madison (USA). Applied Superconductivity Center). 1987. Contract AC03-85SF15934. 207p. NTIS, PC A10/MF A01 - OSTI. Order Number DE88016555/JAW.

This is the final report from the Applied Superconductivity Center of the University of Wisconsin to DOE San Francisco on an innovative Science and Technology contract, "Design Studies for Cryoresistive and Superconductive Magnetic Energy Storage for Space Use." The two year study from September 1985 through 1987 is to develop concepts for space-based, pulsed, cryoresistive and superconductive magnetic energy storage and delivery systems. In particular, the shielded, superconducting toroidal concept is analyzed, evaluated, and compared to cryoresistive solenoids and toroids.

8622 **(JAERI-M—88-189) CASKETSS-DYNA2D: a nonlinear impact analysis computer program for nuclear fuel transport casks in two dimensional geometries.** Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 98p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756068/JAW.

A nonlinear impact analysis computer program DYNA2D, which was developed by Hallquist, has been introduced from Lawrence Livermore National Laboratory for the purpose of using impact analysis of nuclear fuel transport casks. DYNA2D has been built in CASKETSS code system (CASKETSS means a modular code system for CASK Evaluation code system for Thermal and Structural Safety). Main features of DYNA2D are as follows; (1)

This program has been programmed to provide near optimal speed on vector processing computers. (2) An explicit time integration method is used for fast calculation. (3) Many material models are available in the program. (4) A contact-impact algorithm permits gap and sliding along structural interfaces. (5) A rezoner has been embedded in the program. (6) The graphic program for representations of calculation is provided. In the paper, brief illustration of calculation method, input data and sample calculations are presented.

8623 **(K/ETAC—73) Fire vehicle hardening.** Horner, L.G. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 144p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004480/JAW.

After attack, the wartime fire fighter faces a harsh environment in which he must operate to perform his mission. Debris, unexploded bombs, and munitions pose hazards that must be overcome. Without modification to the fire-fighting vehicles, there is little assurance that the fire fighter would even be able to reach the locations necessary for performing his mission. Adding armor to the vehicle to protect both the operator and the vehicle from these hazards is the proposed solution. Through a study performed by the BDM Corporation under a subcontract to Martin Marietta Energy Systems, Inc., the recommended types, thicknesses, and locations of material necessary to allow the P-19 crash-rescue fire vehicle to survive, with 95% probability, 100 random events using the NATO Standard Fragment Threat Criteria was determined. Using this information, a preliminary design for a prototype hardening kit for the P-19 was developed. In conjunction with this effort, a P-19 was modified by installing attachment points, and mock-up armor was fabricated and fitted to the vehicle to refine the design. The kit design consisted of (1) various mild steel panels that varied in thickness from 0.125 to 0.375 in., (2) Lexan panels for areas that had to be transparent, (3) flexible Kevlar 49 for areas requiring flexibility, and (4) foam-filled tires. The factors considered in the design were the effects on the vehicle, fragment-stopping ability, weight, cost, ability to fabricate, and ease of installation. 40 figs.

8624 **(ORNL/CSD/TM—247) Assessment of criticality computational software for the US Department of Energy Office of Civilian Radioactive Waste Management applications.** Westfall, R.M.; Dyer, H.R.; Petrie, L.M. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004314/JAW.

State-of-the-art computational software was evaluated relative to the performance of criticality analyses of facilities and equipment involved in the handling, transport and storage of spent light-water reactor fuel. It was determined that the KENO V.a Monte Carlo program was the most suitable. Of the other programs evaluated, the MONK6.2 code was found to be the leading candidate for the performance of independent, corroborative analyses. The validation of cross-section data from the SCALE system for shipping cask and fuel consolidation applications was reviewed. For current design practices, the data validation is adequate. For new design approaches, such as neutron flux traps or taking credit for fission product absorption, additional validation studies must be performed. 45 refs., 4 figs., 13 tabs.

8625 **(ORNL/ENG/TM—34) US Marine Corps assault amphibious vehicle suspension system analysis.** Hammonds, C.J.; Jones, J.K.; Mayhall, J.A.; Williamson, D.E. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 141p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004320/JAW.

In response to a request from the US Marine Corps (USMC), the Oak Ridge National Laboratory investigated a problem with the suspension system of the assault amphibious vehicle (AAV), Personnel Model 7A1. In the course of the investigation, drawings of the AAV and field survey data on bearing failures provided by VSE Corporation were used. The analysis approach taken was to model the suspension system and the vehicle hull and support structure using finite element techniques. This provided stress and deflection information for the system. To determine the loads imparted to the system as the AAV traversed terrain features, a dynamics model was developed to provide loads to the finite element analysis (FEA). Because the primary indication of a problem was frequent suspension-system bearing failure, an analysis of the suspension-system bearings was conducted. Finally, to check the accuracy of the models and to provide actual load data for bearing analysis, an instrumented AAV was tested over a surveyed course at Camp Pendleton, California. Initially the dynamics model assumed the interface between the hull and the suspension system to be fixed. Later improvements incorporating the flexibility of the vehicle hull into the analysis by linking the two models resulted in improved accuracy. Actual measurements of the front road-arm displacement and vertical acceleration of the chassis are compared with predictions from the model. The correlation is quite good and indicates that the model can accurately predict the dynamic load on each road wheel for input into finite element analyses. The dynamics model can be expanded to study the effects of adding weight to the vehicle, traversing other terrains, or evaluating inputs such as weapons firing or drop tests. 7 refs., 75 figs., 10 tabs.

8626 **(PB—88-249958/XAB) Asbestos substitute fabrics for safety clothing. Progress report, 28 September 1979-31 December 1982.** Barker, R.L. (North Carolina State Univ., Raleigh (USA). Dept. of Textile Materials and Management). Jan 1983. 11p. NTIS, PC A03/MF A01.

See also PB—84-238385.

Samples of over 70 different heat-resistant fabrics were obtained and tested for flammability, thermal shrinkage, molten iron penetration, and degradation. Other studies have sought to evaluate tensile strength, tearing strength, abrasion resistance, flexibility, air permeability, and thermal insulation value of the materials. A computer system was developed to handle the data generated from the studies. Information needed to define the performance criteria for such clothing was gathered through reviews of the literature, reports of industrial safety engineers, standards listed in ASTM Committee F23.80 on protective coverings, and from the manufacturers themselves.

8627 **(PB—88-252200/XAB) Quality measurements in resonant cavities for microwave-property study of superconductive materials.** Dekkers, G.; de Ridder, M. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands)). 9 May 1988. 154p. (In Dutch). (LINO—155). NTIS, PC E07/MF A01.

8628 **(PB—89-103972/XAB) Semiannual compilation of project briefs, August 1988 (Power Information Center).** (CSR, Inc., Washington, DC (USA). Power Information Center). Aug 1988. 62p. NTIS, PC A04/MF A01.

See also PB—88-100177.

This document represents a listing of the projects maintained in the PIC automated data base from February 1988 to July 1988. The information is presented in two categories. Part I is a listing by field of interest of the IAPG project briefs that were active or closed out during the aforementioned time period. The fields of interest are chemical, electrical, magnetohydrodynamics, mechanical, nuclear, solar, and systems energy research. The listing is alphabetical within each field of interest and gives the brief number, title of the project, project manager, directing agency code, research facility, funding information, and current status by code (ON = ongoing, CO = completed, CA = cancelled, CL = closed out.) Part II is a subject index of the project briefs included in the issue.

8629 **(PB—89-107700/XAB) Center for Electronics and Electrical Engineering Technical Publication Announcements covering Center programs, January to March 1988 with 1988 CEEE events calendar.** Walters, E.J. (National Bureau of Standards, Washington, DC (USA). Center for Electronics and Electrical Engineering). Sep 1988. 18p. (NBSIR—88/3854). NTIS, PC A03/MF A01.

See also PB—88-232913.

This is the sixteenth issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology (formerly the National Bureau of Standards) Center for Electronics and Electrical Engineering. The issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the first quarter of calendar

year 1988. Abstracts are provided by technical area for papers published this quarter.

8630 **(PB—89-850044/XAB) Robots for hazardous duties: military, space, and nuclear facility applications. October 1986-October 1988 (Citations from the NTIS data base). Report for October 1986-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 156p. NTIS PC N01/MF N01.

Supersedes PB—88-851902.

This bibliography contains citations concerning the design and application of robots used in place of humans where the environment could be hazardous. Military applications include autonomous land vehicles, robotic howitzers, and battlefield support operations. Space operations include docking, maintenance, and mission support, both intra-vehicular and extra-vehicular activities. Nuclear applications include operations within the containment vessel, radioactive waste operations, fueling operations, and plant security. Many of the articles reference control techniques and the use of expert systems in robotic operations. Applications involving industrial manufacturing, walking robots, and robot welding are cited in other published searches in this series. (This updated bibliography contains 262 citations, 174 of which are new entries to the previous edition.)

8631 **(PB—89-850234/XAB) Circuit breakers: medium- and high-voltage air and gas blast, and arc-quenching breakers. January 1975-October 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 79p. NTIS PC N01/MF N01.

This bibliography contains citations concerning medium- and high-voltage air, gas, and arc-quenching circuit breakers. Topics discussed include the protection of transformers, fire protection, self-extinguishing devices, contact materials, sand breakers, and oil-filled breakers. Breaker reliability, development, and operation is examined. Supplying air and gas for these breakers is briefly considered. (Contains 186 citations fully indexed and including a title list.)

8632 **(PB—89112213/XAB) Numerical study of nonlinear wave interactions in bubbly two-phase flow.** Vreenegoor, A.J.N.; Wilders, P.; Geurst, J.A. (Technische Hogeschool Delft (Netherlands). Dept. of Mathematics and Informatics Computer Science). 1988. 22p. (REPT—88-50). NTIS, PC E03/MF A01.

Recently variational methods were applied for the systematic derivation of two-phase flow equations governing the inviscid dynamic behavior of bubbly liquid/gas mixtures. The corresponding equations, which possess real characteristics at marginal stability, are investigated here with respect to their suitability for producing stable and reliable numerical results. The applied numerical method is based on a scheme introduced by Lerat. The interaction of acoustic waves and nonlinear concentration waves is used as a test case. The principal results of the report are presented at the XVIIth International Congress of Theoretical and Applied Mechanics to be held at Grenoble, August 21-27, 1988.

8633 **(PB—89112544/XAB) Impact analysis of shipping container for radioactive material. Technical report.** Guo, Z.; Wang, Z. (Dalian Inst. of Tech., LN (China)). 1987. 8p. NTIS, PC E03/MF A01.

Analysis is made for shipping containers of nuclear fuel. With the lumped-mass nonlinear spring model(5), a program is written to predict the impact response of the containers. Numerical and experimental results are presented to show the efficiency and the validity of the method.

8634 **(PB—89112957/XAB) Cryostat with high-stability AI (artificial intelligent) control. Technical report.** Tu, X.; Zhang, Z.; Li, W.; Zhang, L.; Cheng, Z. (Beijing Polytechnic Univ., BJ (China)). 1987. 11p. NTIS, PC E03/MF A01.

A cryostat using AI (Artificial Intelligent) control for low-temperature calibration is described. Its transducer as well as power unit, and particularly its AI controller is discussed in detail. The controller can improve the control quality several times, while the related equipment is unchanged. For instance, the temperature stability in the range 13 to 120 K was better than 0.4 mK/h, showing the controller an excellent on-line adaptive control system. It is pointed out that all functions were carried out by means of a simple microcomputer.

8635 **(PNL—6783) The potential for air flow reduction in fume hoods at Hanford.** Enderlin, W.I. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004980/JAW.

The objective of this task is to investigate the feasibility of reducing air flow at the face of laboratory hoods at Hanford during off shift hours for the purpose of energy conservation. Identifying strategies and systems currently available on the market that would facilitate such a reduction, should it be deemed feasible, is also an objective. This report discusses the methodology employed in performing this investigation and the findings resulting therefrom and sets forth conclusions and recommendations derived from these findings. A bibliography and list of references are included. 9 refs.

8636 **(SAND—88-0441C) Identity verifier performance.** Maxwell, R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 33p. (CONF-8710162—1-Vugraphs). NTIS, PC A03/MF A01 - OSTI. Order Number DE88006163/JAW.

From Smart card applications and technologies conference; Atlantic City, NJ, USA (12 Oct 1987).

This report is a transcript of a paper given at the Smart Card Applications and Technologies Conference, October 14, 1987. Identity verification techniques are identified and discussed, and statistical performance data is given. 20 figs. (JF)

8637 **(SAND—88-1449) A local isotropic/global orthotropic finite element technique for modeling the crush of wood.** Attaway, S.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004663/JAW.

Wood has often been used as the crushable material in impact limiters. However, the analysis of wood has been difficult because of its orthotropic crush behavior. A micro-mechanical technique for analyzing crushable orthotropic materials, such as wood, has been developed. Alternating layers of hard and soft isotropic material were used to produce global orthotropic behavior. This technique captured many of the phenomena observed with large crush of orthotropic materials. Crush stresses at different angles of loading with respect to the grain obtained with this technique compared well with Hankinson's empirical formula and with the Tsai-Wu failure criterion for orthotropic materials. Shear strain localizations, which have been observed experimentally in tests with loading parallel to the grain, were also predicted using the alternating layer model. In order to verify the constitutive behavior of the local isotropic/global orthotropic model, a parametric study of a simple wood sample crushed at different grain angles was performed. Following completion of the verification study, the technique was applied to the analysis of a transportation cask impact limiter that contained wood as part of its energy absorbing matrix. The analysis was repeated with an isotropic material model for comparison, and the differences between the results from the two studies will be discussed. 34 refs., 26 figs.

8638 **(SAND—88-2808) Chemical typing modifications to IPA57.** Chambers, W.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004668/JAW.

A set of modifications to the chemical typing section of IPA57, the Imaging and Particle Analysis program written by Tracor Northern for use with their TN5700 image processor is described. The primary modifications provide for classification of particles by specifying acceptable ranges of each detected element and enhance the elemental discrimination capabilities by incorporating a least squares fitting technique for deconvolution of the energy dispersive x-ray data which are used to determine the chemistry of

each particle. Other modifications increase the number of elements that can be considered from 25 to 31, provide some memory and speed enhancements, and improve the file handling capabilities of the program. 4 refs.

8639 **(SAND—88-2917C) Structural dynamics considerations for structural control.** Lauffer, J.P.; Allen, J.J.; Peterson, L.D. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 6p. (CONF-890225—4). NTIS, PC A02 - OSTI. Order Number DE89002989/JAW.

From International modal analysis conference; Las Vegas, NV, USA (3 Feb 1989).

A program was initiated to develop the capability to design and implement structural control. To provide focus for the program, we performed a structural control experiment. The control structure experiment consisted of a flexible truss structure, and piezoelectric actuators and sensors. The controller was designed by reducing the system model, using the concept of model cost, and implementing a conventional LQG controller. The experiment showed that the controller was highly sensitive to errors in modal frequencies and mode shapes. To achieve an effective controller, it was necessary to obtain a model which predicted the modal frequencies to within 1% of experimental results. 9 refs., 11 figs., 4 tabs.

8640 **(UCID—19325-Vol.1) NEWTWC: A DDAC program for transient waveform testing: Volume 1, User's manual.** Moccia, D.J.; Nesbit, E.E.; Horrillo, T.A.; Friedman, G. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 266p. NTIS, PC A12/MF A01 - OSTI. Order Number DE89003414/JAW.

NEWTWC is a DDAC control task designed to help operators conduct transient waveform tests on the elctrodynamic shaker at Building 854 of LLNL's Site 300. Like other DDAC control tasks, NEWTWC is a menu-driven system that guides the operator through the four parts of dynamic testing: test set-up, calibration/noise identification, execution, and post-test data reduction. During each of these parts, NEWTWC interacts with the operator in an informative and easily understood manner. During test set-up, as the operator defines the test to be run, NEWTWC displays coherent blocks of test parameters for examination and modification, providing the operator with appropriate prompts and with legal values for each parameter. After the operator has defined a test, NEWTWC provides the capability of saving that test in the DDAC test library. During execution, NEWTWC controls the shaker to an operator-defined reference, captures specimen data, writes it onto magnetic tape, and presents real-time information. After execution is completed, NEWTWC leads the operator into the GPDAP data reduction program, where he can read the test's data tape and reduce the data to a final form. 6 refs., 45 figs.

8641 **(UCID—21576) Second status report on development activities for a 21-T superconducting magnet and cryostat.** Miller, J.R.; Kerns, J.A.; Slack, D.S.; Strum, M.J.; Summers, L.T.; Viveros, G. (Lawrence Livermore National Lab., CA (USA)). 10 Nov 1988. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004604/JAW.

We have continued our efforts to characterize the materials and cryogenics systems to be used in the 19-T model coil and eventually the 21-T spectrometer magnet. Characterization of titanium-alloyed internal-tin superconducting materials has shown that high critical-current densities at high magnetic fields are readily available. The current densities to date are sufficient to make possible magnets of 21 T. Ta-alloyed wires, due to their higher H/sub c2/, should show increased current densities over the Ti-containing wires and offer improved operating margins. Mechanical tests of Ti-alloyed superconductors have shown J/sub c/ vs strain sensitivities that agree with accepted models for $Nb_3Sn$ wires. Irreversible damage limits are quite high (ϵ/sub irrev./>0.8% intrinsic). These results indicate that, with proper strain management, internal-tin superconductors will be acceptable for use in the 21-T coil. The sensitivity of wires with high areal reduction to mechanical damage prior to reaction has been successfully addressed by the use of low-temperature-annealing heat treatments. The low-temperature anneals do not measurably affect wire performance otherwise. A number of epoxy resins have been evaluated, and at least one viable candidate for the 21-T coil has been found. Tests to determine the wettability and wicking characteristics have shown the candidate resin to have ideal handling characteristics and the ability to fill tightly wound coils when Vacuum Pressure Impregnation (VPI) techniques are used. Design of the 1.8 K cryogenic system for model coil testing has been completed and construction is proceeding. All major components have been fabricated. A preliminary design of the cryostat for the spectrometer magnet has also been completed. Expected cryogenic loads and cryogen usage have been estimated.

8642 **Feasibility of the high T/sub c/ superconducting bolometer.** Richards, P.L.; Clarke, J.; Leoni, R.; Lerch, P.; Verghese, S.; Beasley, M.R.; Geballe, T.H.; Hammond, R.H.; Rosenthal, P.; Spielman, S.R.; and others. (Department of Physics, University of California, and Center for Advanced Materials, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **54**: No. 3, 283-285(16 Jan 1989).

A design analysis is given for a bolometric infrared detector that uses the resistive transition of a high-temperature superconductor as the temperature sensing element, and liquid nitrogen (LN) as the coolant. It is shown that for highly oriented c-axis films, the measured low-frequency noise causes little or no degradation of the performance. With the incoming radiation chopped at 10 Hz, noise equivalent powers (NEP) in the range (1—20) x 10/sup -12/ W Hz/sup -1/2/ should be achievable. These values compare favorably with the NEP of other detectors operating at or above LN temperatures for wavelengths greater than 20 μm.

8643 **Cryogenic sample manipulator for multipurpose sample analysis.** Chia, V.K.F.; Veirs, D.K.; Rosenblatt, G.M. (Lawrence Berkeley Laboratory, Material and Chemical Sciences Division, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 108-109(Jan 1989).

A cryogenic sample manipulator for ultrahigh vacuum studies of surfaces by Raman spectroscopy of physisorbed gasses is described. The development of a cryogenic off-axis sample manipulator that can be cooled to 15 K and allows the sample to be placed at any distance desired from the rotational axis is reported in this paper. (AIP)

8644 **(OA-Trans—3286) Induction heating equipment.** (Electricity Council, London (UK). Overseas Relations Branch Translations Service). Aug 1988. Translated from French Patent Application No. 77 01909. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89004464/JAW.

The present invention concerns an induction heating apparatus which includes a heating element and a hollow part to receive the material to be heated. The heating element is itself heated by electromagnetic induction produced from source of supply at mains frequency. 10 figs.

8645 **Advances in cryogenic engineering. Volume 33 - Proceedings of the Cryogenic Engineering Conference, Saint Charles, IL, June 14-18, 1987.** Fast, R.W. New York, NY; Plenum Press (1988). 1199p. (CONF-8706125—).

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

Papers are presented on superconductivity applications including magnets, electronics, rectifiers, magnet stability, coil protection, and cryogenic techniques. Also considered are insulation, heat transfer to liquid helium and nitrogen, heat and mass transfer in He II, superfluid pumps, and refrigeration for superconducting systems. Other topics include cold compressors, refrigeration and liquefaction, magnetic refrigeration, and refrigeration for space applications. Papers are also presented on cryogenic applications, commercial cryogenic plants, the properties of cryogenic fluids, and cryogenic instrumentation and data acquisition.

## 4203 Lasers

*REFER ALSO TO CITATION(S) 8017, 8391, 8406, 8492, 8493, 8729, 8730, 8790, 9085, 9111, 9767, 9814, 9952, 9953, 10320*

**8646 (AD-A—197184/5/XAB) High-radiance pulsed lasers. Final report, August 1985-June 1987.** Klunk, S. (Laser Diode, Inc., New Brunswick, NJ (USA)). 2 Jul 1987. 21p. NTIS, PC A03/MF A01.

The objective of this contract was to design, develop, test, and deliver six (6) pulsed-laser modules. These devices combined 10 to 12 pulsed GaAlAs injection lasers into a compact package using fiber-optic coupling to achieve a high radiance. The delivered devices had a nominal peak power of 100 watts in a 40-ns pulse at a repetition rate up to 50 kHz. The emitting aperture was 0.010 inch square. The devices were designed to be driven by a Power Technology model ILM pulser.

**8647 (AD-A—197190/2/XAB) Geometrical limitations in grating pair pulse compression.** Brorson, S.D.; Haus, H.A. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1 Jan 1988. 4p. NTIS, PC A02/MF A01.

Pub. in Applied Optics, Vol. 27, No. 1, 23-25(1 Jan 1988).

Optical-pulse compression using gratings has become a standard technique for producing ultrafast pulses outside a laser cavity. Short pulses produced by a mode-locked laser are focused into an optical fiber. There, self-phase modulation and group velocity dispersion act to broaden the bandwidth of the pulse and impart to it a negative chirp. A pair of diffraction gratings are placed following the fiber. Different frequencies follow different paths through the grating pair; if they are properly oriented, the gratings can compensate for the linear chirp of the pulse. In this way the spectral components of the pulse are compressed in time. The net effect of the system is to produce an output pulse that is shorter than the input pulse because of the additional frequencies generated in the fiber.

**8648 (AD-A—197228/0/XAB) Development of a stretchable concave-imaging membrane mirror of variable focus. Final technical report, 6 January 1987-6 January 1988.** Waddell, P. (Strathclyde Univ., Glasgow (UK). Div. of Thermo-Fluid and Environmental Engineering). 20 Mar 1988. 34p. NTIS, PC A03/MF A01.

This report describes the evolution of a plastic-membrane, variable-focus, concave-imaging mirror, a zoom mirror. A partial vacuum behind the membrane is used to create a uniform pressure difference across the membrane and force it back into a concave shape. Range of curvatures (obtainable) is from the flat to F/0.5, the classical limit for imaging in concave mirrors. Plastic membranes were metallized with surface roughnesses down to 10 angstroms, as good as any mirror polished to date. Shearing interferometry was used to study mirror symmetry. Frames are being evolved to support the membrane in such a way that the mirrors will be interferometrically symmetrical and capable of excellent imaging. Plastic membranes can be obtained to 17 meters wide, enabling mirrors to around 50 feet in diameter to be built and capable of optical imaging. A space mirror was built, capable of operation even in a total vacuum. The mirrors are vacuum-sealed and can retain any one curvature for long periods of time. The mirrors have been used with gas lasers to create very large-sized holograms and white light holograms.

**8649 (AD-A—197284/3/XAB) Bibliography of Soviet laser developments, Number 89, May-June 1987.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). 20 Apr 1988. 161p. (DIA-DST—2700Z-003-88). NTIS, PC A08/MF A01.

This is the Soviet Laser Bibliography for May-June 1987, and is No. 89 in a continuing series on Soviet laser developments. The coverage includes basic research on solid-state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

**8650 (AD-A—197444/3/XAB) Pressure dependence and thermal quenching of chromium photoluminescence in ordered perovskites.** Bartram, R.H.; Dolan, J.F.; Charpie, J.C.; Rinzler, A.G.; Kappers, L.A. (Engineers Collaborative Ltd., Chicago, IL (USA)). 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Crystal Lattice Defects and Amorphous Materials, Vol. 15, 165-169(1987).

Low-crystal-field octahedral complexes of $Cr^{3+}$ in solids exhibit broad-band fluorescence, useful in tunable laser applications, rather than the narrow-band phosphorescence of high-field complexes such as ruby. Photoluminescence spectra and lifetimes of potassium sodium gallium hexafluoride: $Cr^{3+}$ and potassium sodium scandium hexafluoride:Cr(3+), measured as functions of pressure and temperature, reveal a pressure-induced transition from broad-band (4 T/sub 2q/ yields 4A/sub 2q/) fluorescence to narrow-band (2E/sub Q/ yields 4A/sub 2Q/) phosphorescence. A theoretical model for radiationless transitions which combines linear coupling to an A/sub 1g/ mode with quadratic coupling to a T/sub 2Q/ mode predicts a pressure-induced increase in fluorescence-quenching temperature. Luminescence lifetime measurements in cesium sodium hexachloride: Cr(3+) reveal that thermal fluorescence quenching in the range 250 K-350 K is completely suppressed at a pressure of 12kbar.

**8651 (AD-A—197450/0/XAB) Phase-shift parameters and small vibrations in resonant optical cavities. Final report, May 1985-September 1985.** Ross, D.M.; Brune, C.; Marrs, C.D. (Naval Weapons Center, China Lake, CA (USA)). Sep 1987. 42p. (NWC-TP—6776). NTIS, PC A03/MF A01.

An exact analysis was performed on a three-mirror passive-cavity reflectometer.

**8652 (AD-A—197516/8/XAB) Quantitative spectroscopy in pulsed power devices. Report for 1 April 1987-31 March 1988.** Griem, H.R. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). 31 Mar 1988. 9p. NTIS, PC A02/MF A01.

This report covers the second stage of an experimental research project directed towards the development of ultrashort-wavelength lasers involving pulsed-power devices rather than cylindrically focused high-power lasers. During this second stage, modifications to the construction of the pinch source were made, and a redesign of the pinch container and pumping mechanism with the aim of enhancing certain diagnostics was undertaken. Diagnostic equipment was procured, constructed, installed, and tested. In addition, a data-acquisition system was procured and is being installed. Further diagnostic equipment was ordered. The experiment has progressed well into the developmental stage.

**8653 (AD-A—197543/2/XAB) Effect of $^{13}C^{16}O_2$ on the performance of a sealed-off pulsed $CO_2$ laser.** Marcus, S.; Stein, D.T. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Apr 1988. 5p. (JA—6038). NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 63, No. 8, 2861-2864(15 Apr 1988).

Operation of a carbon dioxide laser with other than the normal isotopes can be useful in those applications, such as laser radar, which require transmission through extended atmospheric paths, in that the contribution of $CO_2$ to atmospheric adsorption is virtually eliminated. In particular, the upper atmosphere absorption coefficient at the wavelength of the IP(20)transition of $^{13}C^{16}O$ is approximately 200 times less than for the corresponding $^{12}C^{16}O_2$ transition. Since the c-w laser power obtainable with $^{12}CO_2$, as measured by the product of the small-signal gain and saturation intensity, is only about twice that with the $^{13}$Cisotope, there is clearly a potential advantage in the use of $^{13}CO_2$. Pulsed-laser studies have indicated that the advantage could be even greater in that mode of operation, in that pulse energies obtainable with the two isotopes are comparable.

**8654 (AD-A—197622/4/XAB) Coherent addition of AlGaAs lasers using microlenses and diffractive coupling.** Leger, J.R.; Scott, M.L.; Veldkamp, W.B. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 23 May 1988. 4p. (JA—6073). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 52, No. 21, 1771-1773(23 May 1988).

A near single-lobed far-field pattern was obtained from coherent operation of a nonvanescently coupled aluminum gallium arsenide laser-diode array. A diffractive microlens array collimated the individual beams to approximate a plane wave, and diffractive coupling from an external-cavity mirror provided mutual coherence. A diffraction-limited far-field pattern was observed with 82% of the power contained in the central lobe. The method is directly applicable to two-dimensional laser arrays and can be implemented as a single thin optical element.

**8655 (AD-A—197828/7/XAB) Development of sidebands in tapered and in untapered free-electron lasers. Memorandum report.** Hafizi, B.; Ting, A.; Sprangle, P.; Tang, C.M. (Naval Research Lab., Washington, DC (USA)). 1 Jul 1988. 55p. (NRL-MR—6228). NTIS, PC A04/MF A01.

A time-dependent, axisymmetric code is employed to examine the development of sidebands in a free-electron laser. For the case where the input signal undergoes an extended period of exponential growth, a broad spectrum of sidebands with growth rates comparable to that of the signal is excited. In general, in an untapered system the optical field displays considerable modulation after several synchrotron periods. An analytical mode, in qualitative agreement with a number of features of the simulations, is discussed. In a tapered system the amplitude of the sidebands approaches a quasi-steady level that is several orders of magnitude below that of the untapered case, and the output optical field displays only a slight modulation. The optimal rate of tapering employed, to maximize efficiency, leads to substantial reduction in the growth rate of sidebands. This result is discussed in connection with the nonadiabatic nature of particle motion in the tapered system.

**8656 (AD-A—198117/4/XAB) Injection behavior and modeling of 100-mW broad-area diode lasers.** Abbas, G.L.; Yang, S.; Chan, V.W.; Fujimoto, J.G. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Apr 1988. 11p. (JA—6004). NTIS, PC A03/MF A01.

Pub. in IEEE Jnl. of Quantum Electronics, Vol. 24, No. 4, 609-617(Apr 1988).

The output from a single-frequency, narrow-linewidth GaAlAs diode laser was injected into a 100-mW broad-area diode laser. The injected broad-area laser emitted in a single longitudinal mode with up to 80 mW in a single, diffraction-limited, 0.5-FWHM far-field lobe. The angle of the far-field lobe steered with injection frequency and broad-area laser-bias current, displaying behavior similar to that observed with injected gain-guided laser arrays. A Fabry-Perot amplifier model is proposed, which explains the injection behavior in terms of Gaussian beam propagation in a large optical cavity. The model provides criteria for optimizing locking bandwidth, beam steering, and injection efficiency.

**8657 (AD-A—198118/2/XAB) Astigmatic wavefront correction of a gain-guided laser-diode array using anamorphic diffractive microlenses.** Leger, J.R.; Scott, M.L.; Bundman, P.; Griswold, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1988. 9p. (MS—7790). NTIS, PC A02/MF A01.

Pub. in SPIE, v884 Computer Generated Holography II, 82-89(1988).

A diffractive microlens array was used to collimate a one-dimensional array of gain-guided AlGaAs lasers. The astigmatism of the lasers was removed by using anamorphic microlenses. The Strehl ratio of the resulting wavefront was 0.98. The microlens array was placed in an external cavity to produce a single coherent diffraction-limited beam from the AlGaAs laser array.

**8658 (AD-A—198361/8/XAB) Stochastic electron detrapping in FELS (free-electron lasers) caused by sidebands. Memorandum report.** Riyopoulos, S.; Tang, C.M. (Naval Research Lab., Washington, DC (USA)). 14 Jul 1988. 50p. (NRL-MR—6224). NTIS, PC A03/MF A01.

The growth of sidebands in an FEL above a certain threshold will result in stochastic electron motion. This may lead to significant electron detrapping and loss of amplification for the radiation field. The threshold in the sideband amplitude for the stochastic transition is computed. The rate-trapped electrons leak outside the sepratrix is measured by the diffusion coefficient in action space. This approach is general and covers both tapered and untapered wigglers. Three general types of spectra are examined: a narrow, a broad discrete and a broad continuous. Each type is associated with a particular scaling of the diffusion coefficient on the FEL parameters. Numerical results, obtained for constant radiation amplitudes, show good agreement with the theoretical predictions. This diffusion rate is always proportional to the total sideband-to-carrier power ratio, with different coefficients of proportionality for each spectral type. The narrow types of spectrum causes the highest diffusion rates and the broad continuous spectrum causes the lowest diffusion rates under constant total sideband power. The diffusion length, measured in wiggler periods, is independent of the beam energy gamma. Serious deterioration in the FEL efficiency will result when the diffusion length becomes shorter than the wiggler length.

**8659 (AD-A—198556/3/XAB) Semiconductor laser diodes and the design of a dc powered laser diode drive unit. Master's thesis.** Cappuccio, J.C. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 93p. NTIS, PC A05/MF A01.

This thesis addresses the design, development, and operational analysis of a dc powered semiconductor-laser diode drive unit. A laser diode requires an extremely stable power-supply since a picosecond spike of current or power supply switching transient could result in permanent damage. The design offers stability and various features for operational protection of the laser diode. The ability to intensity modulate (analog) and pulse modulate (digital) the laser-diode output for data transmission was a major design consideration. Laser optical power is controlled via a closed-loop system using a monitor photodiode. Laser-diode temperature stabilization is accomplished with the use of a thermoelectric cooler. Laboratory and remote applications were considered in the design of this unit.

**8660 (AD-A—198843/5/XAB) Chemical pump sources for IF(B). Final report, 1 March 1986-4 May 1987.** Davis, S.J.; Woodward, A.M.; Piper, L.G.; Marinelli, W.J. (Physical Sciences, Inc., Andover, MA (USA)). Jun 1988. 91p. (PSI—2000/TR-689). NTIS, PC A05/MF A01.

Excitation of iodine monofluoride (X) by singlet molecular oxygen was studied. Mechanistic investigations revealed that two excitation routes are active, and both require an intermediate state which is most likely iodine monofluoride. The two models hypothesized and tested are described by: (1) iodine monofluoride reacts with singlet sigma oxygen producing the IF(A) state, this state reacts with singlet delta oxygen producing IF(B), (2) vibrationally hot iodine monofluoride reacts with singlet sigma oxygen to produce the IF(A) this reacts with singlet sigma oxygen and produces IF(B).

**8661 (AD-A—198855/9/XAB) Semiconductor-laser-diode arrays by MOCVD (metalorganic chemical vapor deposition). Final report, 1 September 1984-31 August 1987.** Coleman, J.J. (Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering). 1 Sep 1987. 71p. NTIS, PC A04/MF A01.

The purpose of this program is to develop the metalorganic chemical vapor deposition (MOCVD) epitaxial growth process for semiconductor heterostructure laser-diode arrays. These laser diode arrays are intended to be used as an optical pump for solid-state yttrium aluminum garnet (YAG) lasers. In particular, linear uniform arrays having high output power, high efficiency, low laser threshold current density and precisely controlled emission wavelength are required. There are three technical problems associated with

this task. The first problem is development of individual laser-diode device structures that satisfy the requirements for efficiency, threshold, and wavelength control and are suitable for incorporation into laser arrays. There are a number of possible structures varying in complexity from conventional five-layer double heterostructures having alloy AlGaAs active regions to very-sophisticated quantum-well heterostructures (QWH). The second problem is an analytical study of the waveguide properties of multi-element laser arrays. Simple arrays of conventional double heterostructure laser diodes were studied, but extension of this work to other laser-diode geometries is non-trivial. Preliminary and optimum geometries for the individual structures and the photomasks used for device processing require some modeling of the optical properties of these arrays. The third problem, and the major point of this entire program, is experimental development of suitably designed individual laser-diode structures in a well-modeled multi-element array.

8662 **(AD-A—199192/6/XAB) Gadolinium scandium gallium garnet (gsgg) as a solid-state laser host. Final technical report, March-May 1987.** Pratt, H.L. (Army Missile Command, Redstone Arsenal, AL (USA). Advanced Sensors Directorate). Jul 1987. 30p. (AMSMI/TR-RD-AS—87-14). NTIS, PC A03/MF A01.

This report addresses the solid-state laser host material GSGG (Gadolinium Scandium Gallium Garnet) and its application in two separate types of lasers. First, GSGG is treated as the host material for chromium-doped lasers tunable in the near-infrared spectral region. Second, neodymium-doped GSGG, with and without chromium as a sensitizing codopant, is considered as a potential direct replacement for Nd:YAG for improved performance. Closely related garnet materials similar to GSGG are also briefly considered.

8663 **(AD-A—199265/0/XAB) Nonlinear mixing and phase conjugation in broad-area diode lasers.** Lucente, M.; Carter, G.M.; Fujimoto, J.G. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 8 Aug 1988. 4p. (JA—6109). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letter, Vol. 53, No. 6, 467-469(8 Aug 1988).

Four-wave mixing is investigated in broad-area diode lasers. Two external fields are injected into the device using a phase-conjugation geometry and the nonlinear four-wave mixing signal observed by performing spectrally resolved measurement of the far field. By varying the injection geometry, the excited mode of the broad-area diode can be controlled. The gain nonlinearity generates a conjugate wave within the device, thereby resulting in far-field emission in the conjugate direction. Nonlinear conjugate signal-efficiency levels of about - 21 dB have been observed.

8664 **(AD-A—199267/6/XAB) Performance of a prototype module of a 300-watt flashlamp-pumped dye laser.** Zollars, B.G.; Everett, P.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 11 Dec 1987. 8p. (MS—7758). NTIS, PC A02/MF A01.

Pub. in Proceedings of the International Conference on Lasers '87, 297-303(11 Dec 1987).

Recent performance measurements on a prototype module of a multi-beam, flashlamp-pumped dye-laser system are discussed. Measurements of the total output energy of the dye laser and its distribution in the far field are presented for operation at a 5-Hz repetition rate. The implementation of a real-time dye-regeneration system and the choice of an optimum dye solvent are addressed. A large, multi-beam, flashlamp-pumped dye-laser system is being constructed for a field experiment. Performance measurements made on a prototype module of this laser system are presented. A test bed was assembled at the Laboratory that has the capability of supporting two of these dye-laser modules, and implements many of the unique features of the final system, such as on-line laser-performance diagnostics and the capability to overcome the detrimental effects of finite dye lifetime during operation of the system. The laser system test bed has fluid control, cooling, and electrical support for two separate laser beams working at full output power. There is also a provision for operating three laser beams at a reduced power level. This system has yielded valuable data on both laser performance and engineering aspects. Among the innovative features of the dye-laser system is the ability to run the lasers for extended periods of time without suffering the deleterious effects of dye degradation. Instruments monitor the level of photodegradation products in the dye process stream and direct a fraction of the dye into a carbon absorber, where the degradation products are removed.

8665 **(AD-A—199471/4/XAB) Evaluation of optical-materials samples. Final report.** (Dayton Univ., OH (USA). Research Inst.). Jul 1988. 81p. (UDR-TR—88-89). NTIS, PC A05/MF A01.

The primary objective of order subcontract was to prepare AGT and UGT test specimens, provide characterization data and provide damage assessments on tech-base laser-mirror materials being developed on other government contracts. The properties to be determined included flexural strength, Young's modulus, Poisson's ratio, fracture toughness (KIc), coefficient of thermal expansion, thermal diffusivity, hardness, and specific heat. In some cases, scanning electron microscopy (SEM), x-ray diffraction (XRD), energy dispersive x-ray analysis (EDAX), and Auger spectroscopy (AES) were to be performed to determine chemical composition and crystal structure and damage mechanisms. In addition, if materials problems occurred that could not be anticipated in advance, studies were to be initiated to aid the SDI optical-materials efforts as required.

8666 **(BF-R—66.090-1) Spaceborne lidar: Development of a laboratory test system. Final report.** Endemann, M.; Klein, V.; Hoeffgen, H.J.; Malvichini, C.; Mombrini, G.; Nava, E. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Feb 1988. 159p. (ESA-CR(P)—2605; ETN—88-93035). NTIS, PC A08/MF A01.

The design, realization, and testing of a functional backscatter lidar intended to validate the overall system design concept of operational spaceborne lidar instruments, and to aid in the development and optimization of the lidar components are described. It is a compact lidar that allows easy modification of components to verify their performance in the overall system. It performs atmospheric measurements through the window of a laboratory and thus is not optimized with respect to size, mass, and power consumption. A fiber optics coupler connects the scanning receiving telescope with the detector package. Thus the positioning of the detectors becomes uncritical for the instrument alignment, allowing use of a particularly simple and light structure that still warrants high alignment stability of the components. This scanner arrangement performs well in tests and is recommended as baseline design for the spaceborne lidar. A frequency-doubled Nd:YAG transmitter laser is suggested.

8667 **(BNL—41920) Computation of emittance growth in a focusing wiggler FEL [Free Electron Laser].** Ben-Zvi, I.; Wachtel, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-8808146—11). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004515/JAW.

From 10. international free-electron laser conference; Jerusalem, Israel (29 Aug 1988).

Computed electron trajectories in a free electron laser show significant emittance growth in the wiggle plane when there are wiggler field gradients. For a low gain free electron laser using a focusing planar wiggler, phase space plots show the development of this 3-dimensional effect as well as rotation of the phase space region occupied by the beam due to betatron oscillations in the focusing wiggler field. Matching the input electron beam to the wiggler eliminates emittance growth. 3 refs., 5 figs., 1 tab.

8668 **(CONF-881002—33) Laser damage studies of ZnS via neutral Zn particle emission.** Arlinghaus, H.F.; Calaway, W.F.; Young, C.E.; Pellin, M.J.; Gruen, D.M.; Chase, L.L. (Argonne National Lab., IL (USA); Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-31109-ENG-38;W-7405-ENG-48. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004212/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Emission of neutral atoms from ZnS surfaces due to laser irradiation has been observed at power densities two orders of mag-

nitude below the single pulse damage threshold of the material. We have measured the velocity distribution and absolute yield of neutral Zn atoms generated by exposure of ZnS single crystals to XeCl excimer laser irradiation (308 nm) using time-of-flight and high-resolution two-photon laser-induced fluorescence spectroscopy. The distributions are in agreement with Maxwell-Boltzmann distributions. The characteristic temperature increases from 2000 to 9000 K as the fluences are raised from 17 to 80 mJ/cm$^2$, respectively. The absolute Zn yield also increases from $10^8$ to $10^{12}$ atoms per laser pulse as the laser fluence is increased. The results suggest formation of a plasma that interacts with the surface and leads to catastrophic failure. For consecutive laser shots at constant laser fluences, a nearly exponential increase in the Zn particle density is observed, yet visible damage did not occur until 150,000 laser shots. Our results show that neutral particle emission is of considerable importance in the identification of fundamental damage mechanisms and that microscopic damage occurs far below the single-pulse damage threshold. 4 refs., 2 figs.

8669 **(LA-UR—88-3983) Excitation of lasing media using antiproton-annihilation products.** Howe, S.D.; Hynes, M.V. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-881244—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003602/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

Lasing has been achieved in many different media using a wide variety of excitation mechanisms including low-energy electron or proton beams and recoiling fission products. In all cases, the power density produced in the medium has been the critical parameter. Recent calculations indicate that a region of high-power density can be achieved in high-density lasing media by allowing antiprotons to annihilate in the material with an intense magnetic field present. Because of the long range of energetic annihilation products, the media can be gaseous, liquid, or solid. The thermalization time is the critical parameter for this excitation mechanism which for liquid-density media, such as Ar-Xe mixtures, is about 2.1 ns. Based on these calculations power density of about 100 MW/cm$^2$ can be achieved using a level of antiprotons that is currently available today. Development of an antiproton pumping source may allow fundamental reaction kinetics in a wide variety of lasing systems to be performed in a university environment. The results of the calculations in a liquid medium and at different magnetic field strength will be presented. In addition, the design of an ongoing experiment using an 800 MeV proton beam to pump a liquid density excimer cavity will be discussed. These preliminary experiments intend to focus on fundamental kinetics and on the effects of a strong magnetic field on reactions. 13 refs., 7 figs.

8670 **(N—89-10277) Studies of blackbody-pumped lasers. Semiannual progress report, 1 January-30 June 1988.** Christiansen, W.H.; Chang, J.; Sirota, M. (Washington Univ., Seattle (USA)). Sep 1988. 19p. (NASA-CR—183214; NAS—1.26:183214). NTIS, PC A03/MF A01.

Laser action was achieved in a large-scale pulsed system and meaningful experiments were carried out in the axial flow facility to understand the physics of solar-pumped lasers. Studies of the variation of laser mixture composition were done for mixtures of CO2 and N2O additions. Theoretical analysis and modeling of the system were also performed based on a model including radiative pumping, diffusion and wall deactivation, and vibrational energy transfer between two optically active species. Qualitative agreement between predictions in the parameter variation and the experimental results were obtained with CO and N2O mixtures. Several experimental studies were performed to quantify the properties of carbon monoxide as absorber and storage of energy in the blackbody pumped system.

8671 **(N—89-11201) Direct solar-pumped iodine laser amplifier. Semiannual progress report, 1 March-31 August 1988.** Han, K.S.; Hwang, I.H.; Stock, L.V. (Hampton Inst., VA (USA)). Oct 1988. 50p. (NASA-CR—183171; NAS—1.26:183171). NTIS, PC A03/MF A01.

A XeCl laser which was developed earlier for an iodine laser oscillator was modified in order to increase the output pulse energy of XeCl laser so that the iodine laser output energy could be increased. The electrical circuit of the XeCl laser was changed from a simple capacitor discharge circuit of the XeCl laser to a Marx system. Because of this improvement the output energy from the XeCl laser was increased from 60 mj to 80 mj. Subsequently, iodine laser output energy was increased from 100 mj to 3 mj. On the other hand, the energy storage capability and amplification characteristics of the Vortek solar simulator-pumped amplifier was calculated expecting the calculated amplification factor is about 2 and the energy extraction efficiency is 26 percent due to the very low input energy density to the amplifier. As a result of an improved kinetic modeling for the iodine solar simulator pumped power amplifier, it is found that the I-2 along the axis of the tube affects seriously the gain profile. For the gas i-C3F7I at the higher pressures, the gain will decrease due to the I-2 as the pumping intensity increases, and at these higher pressures an increase in flow velocity will increase the gain.

8672 **(PB—88-253166/XAB) Unified two-dimensional opto-electronic simulator for semiconductor lasers.** Kurata, M.; Hatakoshi, G. (Toshibe Corp., Tokyo (Japan). Principal Office). 1988. 5p. NTIS, PC E04/MF A01.

Text in Japanese; Included in Toshiba Review, Vol. 43, No. 5, 409-412(1988).

A device model was developed for quantitative characterization of semiconductor lasers, allowing unified treatment of both electronic and optical systems. To permit use of the model as a tool for optimizing the design of actual semiconductor lasers, the main emphasis was placed on accurate results and fast computation as well as the facilitation of data-input procedures and the investigation of computation results. The use of Fermi statistics was introduced instead of Boltzmann statistics to enable accurate device characterization. Interactions between electronic and optical systems were included in carrier generation-recombination terms for consistent solutions of the equations for both systems. The model readily simulated not only fundamental behavior but also higher-order effects peculiar to semiconductor lasers such as spatial hole burning and the appearance of kinks in optical output versus current characteristics.

8673 **(PB—88-870498/XAB) Laser mirrors. January 1971-October 1988 (Citations from the US Patent data base). Report for January 1971-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 61p. NTIS PC N01/MF N01.

This bibliography contains citations of selected patents concerning design and fabrication of laser mirrors. The properties of the laser mirrors include cooling, thermal stability, and corrosion and damage resistance. Design features include mirror substrates, automatic alignment, mounts, and detection of defects. Applications include lasers for medical, industrial, commercial, and defense uses. (Contains 125 citations fully indexed and including a title list.)

8674 **(PB—89-104228/XAB) Studies of laser-diode technologies (1). Report for December 1984-November 1985.** Lee, S.C.; Lin, H.S. (National Taiwan Univ., Taipei). 1986. 65p. NTIS, PC E04/MF E04.

See also PB—89-104236.

The purpose of this study is the fabrication of the AlGaAs/GaAs buried heterostructure (BH) laser. Two steps of liquid-phase epitaxy and preferential etching techniques were applied to the fabrication processes. The filamentary (Al,Ga)As active region was made in an extremely small size and embedded in the higher-bandgap (Al,Ga)As material. This buried heterostructure was used to concentrate the diode current to the active region. Consequently, the threshold current could be greatly reduced and the number of transverse modes can also be limited. The key step to realize this type of laser was to mesa etch the epitaxial layers down to (n)-GaAs substrate and make use of the high density of nucleation centers at the mesa-etched sides to grow the burying layers. After the second step of LPE growth, the filamentary active region was completely buried by higher-bandgap material. An e-beam evaporated 3000-5000 A $SiO_2$ was used as a mask for Zn diffusion and for lateral-current confinement. A novel microcleavage technique was developed for cleaving laser chip. The superiority of the BH laser over conventional injection lasers was confirmed in the study, the lowest threshold current turns out to be only 25 mA and single mode operation persists at high-injection current.

8675 **(PB—89-104236/XAB) Studies of laser diode technologies (2). Report for August 1985-July 1986.** Lee, S.C.; Lin, H.S. (National Taiwan Univ., Taipei). 1986. 74p. NTIS, PC E04/MF E04.

See also PB—89-104228. Portions of this document are not fully legible.

The purpose of this study is the fabrication of the AlGaAs/GaAs ridge-waveguide laser. Using only one-step LPE growth and preferential etching techniques, a ridge waveguide laser can be reproducibly fabricated that exhibits a fundamental transverse-mode operation at currents up to about three times threshold with output power more than 13 mW under pulsed operation. Thus, the ridge laser is potentially a high-yield economical source for wide industrial applications. Ridge-waveguide lasers of four different ridge configurations were studied: (1) Simple 10-micrometer-wide ridge lasers generally result in multimode operation, while (2) simple 5-micrometer-wide ridge-lasers always exhibit fundamental-transverse-mode operation, (3) in the multisection ridge-laser structure, longitudinal mode selection due to the couple-cavity effect was observed and single frequency operation was achieved. In this structure, stable single transverse-mode operation was obtained up to about three times threshold. (4) 5 micrometer wide shallow-groove ridge laser was also made. The shallow groove terminates slightly above the active region and provides an index perturbation that contributes to mode selection. Almost all the diodes of this structure measured give fundamental transverse-mode operation. A ridge-waveguide laser was successfully fabricated, having a lasing wave length around 7600 A.

8676 **(SAND—88-2998C) Radiation effects in high power laser diodes: Neutrons.** Carson, R.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 32p. (CONF-881247—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003403/JAW.

From Military fibre optic conference '88; Los Angeles, CA, United States (5 Dec 1988).

This presentation outline contains: High power laser diode applications; environmental effects such as nuclear radiation; testing of high power laser diode arrays and broad area laser diodes for response to gamma irradiation, flash x-rays, and neutrons; and the results of neutron irradiation testing.

8677 **(UCRL—99922) Selected topics in FELs.** Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 34p. (CONF-8806263—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004022/JAW.

From International school on electromagnetic radiation and particle beams: physics and applications; Varenna, Italy (20 Jun 1988).

A tutorial introduction to wiggler tapering, electron beam dynamics in the wiggler--with particular emphasis on focusing--and optical guiding is presented. 15 refs., 16 figs.

8678 **(UCRL—99946) X-ray optics for x-ray laser research and applications.** Ceglio, N.M. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 14p. (CONF-880904—4). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004026/JAW.

From 4. topical meeting on short wavelength coherent radiation: generation and applications; Cape Cod, MA, USA (26 Sep 1988).

State of the art capabilities in soft x-ray lenses, multilayer mirrors, beamsplitters, and synthetically generated holograms are reviewed. Application of these capabilities in recent x-ray laser cavity experiments, and to the development of a soft x-ray interferometer and a high intensity ({approx<-gt}$10^{13}$ watt/cm$^2$) soft x-ray laser are discussed. 39 refs., 7 figs., 1 tab.

8679 **High-temperature kinetics in He and Ne buffered XeF lasers: The effect on absorption.** Moratz, T.J.; Saunders, T.D.; Kushner, M.J. (University of Illinois, Department of Electrical and Computer Engineering, Gaseous Electronics Laboratory, 607 East Healey, Champaign, Illinois 61820). *Applied Physics Letters;* **54**: No. 2, 102-104(9 Jan 1989).

Excimer lasers excited by electron or ion beams having energy deposition of 100's J/l-script over many microseconds experience a temperature rise of hundreds of degrees (K). The increase in gas temperature may greatly impact both the kinetics and spectroscopic parameters. In this letter we discuss the high-temperature (≦900 K) plasma kinetics and absorption in He and Ne buffered gas mixtures for particle beam pumped XeF lasers. We find both gain and absorption depend differently on gas temperature in these mixtures (absorption decreasing in He mixtures, increasing in Ne mixtures). The differences are attributed to a reduction in diatomic absorbing species with increasing temperature and differences in the temperature dependence of the optical absorption cross sections for $NeXe^+$ and $Xe^+_2$.

8680 **Design and performance of a high-power, synchronized Nd:YAG—dye laser system.** Perry, M.D.; Landen, O.L.; Weston, J.; Ettlebrick, R. (Lawrence Livermore National Laboratory, P.O. Box 808, MC L-473, Livermore, California 94550). *Optics Letters;* **14**: No. 1, 42-44(1 Jan 1989).

The design and performance of a Nd:YAG—dye-laser system capable of producing synchronized peak powers approaching 10 GW is described. The output of the amplified dye-laser system is several millijoules with fully tunable pulses as short as 300 fsec and is optically synchronized with the 3-GW output of an amplified Nd:YAG laser system, permitting a new class of high-intensity pump—probe experiments. By using short (≃70-psec) pulses to pump the dye amplifier, the energy of amplified spontaneous emission is reduced to less than 10/sup -5/ of that contained in the main subpicosecond pulse.

8681 **Time-resolved measurement of double-pass amplification of soft x rays.** Ceglio, N.M.; Gaines, D.P.; Trebes, J.E.; London, R.A.; Stearns, D. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Applied Optics;* **27**: No. 24, 5022-5025(15 Dec 1988).

We report the first time-resolved measurements of emission from a double-pass soft x-ray laser cavity. In these experiments the output signal from a selenium x-ray laser had two temporal components clearly identifiable as the single- and double-pass emission, with the double-pass amplified signal more intense than the single pass. In addition to an unequivocal demonstration of double-pass amplification of soft x rays, the data provide information about the time-dependent gain in these x-ray laser media, suggesting an effective gain-length profile which rises more slowly and falls-off more rapidly than predicted by state of the art hydrodynamics and kinetics codes.

8682 **Scaling of neonlike lasers using exploding foil targets.** Whitten, B.L.; London, R.A.; Walling, R.S. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 12, 2537-2547(Dec 1988).

We present a set of calculations for laser-gain predictions in a neonlike collisional excitation scheme using laser-driven exploding foil targets. The calculation includes three steps: the ionization balance, the neonlike excited-state kinetics, and the hydrodynamics of the exploding foil target. The ionization-balance model solves steady-state rate equations, including excited states, by using scaled hydrogenic atomic physics. The model for the neonlike excited-state kinetics is also steady state and includes the ground state and the 36 n = 3 excited states, with radiative and collisional transitions connecting these states. The plasma conditions in the exploding foil targets are calculated by using the similarity model of London and Rosen. For selected elements in the range $20<Z<56$, we predict the gain for the two most prominent $2p^53p$ to $2p^53s$ (J = 2—1) transitions seen in experiments, the plasma conditions necessary to maximize the gain, and the specifications for the laser driver and target required to reach those plasma conditions. Our predicted gains are larger than those measured in experiments, for reasons we discuss, but our calculations agree qualitatively with the observed trends; the gain peaks for elements around selenium and falls off for both lighter and heavier ions. Neglected effects, such as time-dependent kinetics and radiation trapping, are also discussed.

**8683 Injection locked oscillator system for pulsed metal vapor lasers.** Warner, B.E.; Ault, E.R. (to Dept. of Energy, Washington, DC). US Patent 4,773,073. 20 Sep 1988. Filed date 26 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a pulsed laser comprising: a metal vapor laser cavity including a reflection means for reflecting stimulated laser pulses out from the cavity, means for stimulating the lasing of first seeder laser pulses, each of a first duration and a first mode, to be injected into the laser cavity, means for injecting the first laser pulses through the reflection means into the laser cavity to stimulate lasing of second laser pulses, each of the second laser pulses having a second mode and a longer duration than the first laser pulses. The means for injecting includes: means for matching the mode of the first pulses to the second desired mode of the second pulses of the laser cavity wherein the means for injecting include means for collimating the first pulses for injection into the laser cavity and wherein the means for matching are formed by input/output surfaces of a predetermined curvature on the collimating means, where the input surface is anti-reflection coated and the output surface has predetermined reflection and transmission characteristics.

**8684 (AD-A—197741/2/XAB) Population-inversion nonequilibrium flow-simulation calculations of the capabilities of convection-flow lasers.** Zhongxiang, W. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 24 Jun 1988. Trans. of Lixue Jinzhan (China), Vol. 16, No. 2, 221-227(25 May 1986). (FTD-ID(RS)T—0263-88). 20p. NTIS, PC A03/MF A01.

Fluid mechanics and nonequilibrium-state thermal dynamics are brought together to form hot gas dynamics. The test production of high-power lasers has quickly developed. The flow movements of working media have important effects on high-power laser devices. (1) The convectionary heat diffusion heat dissipation. (2) Flow movements make the working medium constantly replace itself. This makes it possible to maintain the stability of the working medium as well as to continuously replenish the energy source. (3) It is possible to make use of rapid expansion to directly form population inversion. Because of this, the high-power lasers which currently exist - gas flow lasers, flow movement, and electrical discharge lasers, quasi-molecular lasers, chemical lasers, and other similar devices make use of reactive flow gases to act as working media.

**8685 Application of high-speed photography to time-resolved wavefront measurement.** Neal, D.R.; Sweatt, W.C.; Alford, W.J.; McArthur, D.A.; Hays, G.N. (Sandia National Labs., Albuquerque, NM (US)). pp 52-56 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

For long-pulse (150 microseconds), side-pumped lasers, such as dye or reactor-pumped lasers, a significant transverse index gradient can develop. In order to design an appropriate laser resonator for efficient power extraction, a detailed space- and time- resolved determination of the index perturbation is required. The authors applied high-speed photography to the measurement of wavefront errors in a pulsed laser gain region using a fast framing camera. They utilized both a derivative of a Hartmann test technique and a shearing interferometer, with good agreement between the two. The measured wavefronts have a predominantly parabolic index shape except near the walls, with a roughly linear time dependence during the pumping pulse.

**8686 Method for single-shot measurement of picosecond laser pulse-lengths without electronic time dispersion.** Kyrala, G.A. (Los Alamos National Lab., Physics Div., P.O. Box 1663, MS E526, Los Alamos, NM (US)). pp 203-209 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

A two-source shear pattern recording is proposed as a method for single-shot measurement of the pulse shape from nearly monochromatic sources whose pulse lengths are shorter than their coherence times. The basis of this method relies on the assertion that if two identical electromagnetic pulses are recombined with a time delay greater than the sum of their pulse widths, the recordable spatial pattern has no fringes in it. At an arbitrary delay, translated into an actual spatial recording position, the recorded modulated intensity will sample the corresponding laser intensity at that delay time, but with a modulation due to the coherence function of the electromagnetic pulse. Two arrangements are proposed for recording the pattern. The principles, the design parameters, and the methodologies of these arrangements are presented. Resolutions of the configurations and their limitations are given as well.

## 4204 Heat Transfer And Fluid Flow

*REFER ALSO TO CITATION(S) 7815, 8005, 8029, 8068, 8600*

**8687 (AD-A—197454/2/XAB) Parallel algorithms in the finite-element approximation of flow problems. Final report, May 1987-May 1988.** Gunburger, M.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mathematics). 29 May 1988. 20p. NTIS, PC A03/MF A01.

A portion of the research carried out during the past years under AFOSR sponsorship is discussed. This includes work on finite-element methods for a Ladyshenskaya model of viscous incompressible flow, hyperbolic partial differential equations, exterior problems, algebraic turbulence models, stream-function vorticity formulations of viscous flows and first-order elliptic systems of partial differential equations, and on substructing methods for the approximate solution of partial differential equations.

**8688 (AD-A—197939/2/XAB) Underexpanded noncondensing turbulent gas jets in liquids. Final report, 1 August 1985-30 August 1988.** Loth, E.; Faeth, G.M. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). Aug 1988. 79p. NTIS, PC A05/MF A01.

The structure of turbulent noncondensing round and plane air jets submerged in still water were investigated experimentally. Both adapted and underexpanded jets were considered, the latter with underexpansion ratios up to 8:1. Measurements included flow visualization, using flash photography and shadowgraphs as well as high-speed motion-picture photography; mean void fraction distributions, using gamma-ray absorption; entrainment rates, using laser-Doppler aneomometry; and mean static pressures, using static-pressure probes. Present measurements and the earlier results of Bell et al. (1972), Tross (1974) and Carreau et al. (1985) were used to evaluate analysis of the process. The analysis was based on the locally-homogeneous-flow approximation (relative velocities between the phases neglected) and the effective-adapted-jet approximation for underexpanded jets.

**8689 (AD-A—197942/6/XAB) Dynamic stall computations using a zonal Navier-Stokes model. Master's thesis.** Conroyd, J.H. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 212p. NTIS, PC A10/MF A01.

A zonal Navier-Stokes model is installed and verified on the NASA Ames Cray X/MP-48 computer and is used to calculate the flow field about a NACA 0012 airfoil oscillating in pitch. Surface-pressure distributions and integrated lift, pitching moment, and drag coefficient versus angle of attack are compared to existing experimental data for four cases and existing computational data for one case. These cases involve deep dynamic stall and fully detached flow at and below a free-stream Mach number of .184. The flow field about the oscillating airfoil is investigated through the study of pressure, vorticity, local velocity, and stream function. Finally, the effects of pitch rate on dynamic stall are investigated.

**8690 (AGARD-AG—311, pp 11-53) Hardware architecture, chapter 2.** Neves, K.W. Mar 1988. NTIS, PC A09/MF A01.

In Computational fluid dynamics: algorithms and supercomputers.

An overview of computer architectures is given. The purpose is not to offer a text book description of the electronics behind computing, but rather an appreciation of the barriers on computer development that have led to the complex design of today's supercomputers. This introductory section will examine: (1) the need for increased computer power as a result of the pressure from new computational processes; (2) the limits and barriers of hardware; (3) a brief history of parallelism; and (4) an overview of parallelism in today's computers. Following this Background section, an indepth look at today's supercomputer architectures and emerging computer products is given. In chapter 3, the impact of new hardware architecture on algorithms will be examined. Like computational fluid dynamics, supercomputing has developed a set of terms, definitions, and ad hoc descriptions of common processes. In this monograph most of these terms will be defined when used. Nevertheless, in an attempt to aid the reader, an informal glossary of supercomputing terms is included in an appendix.

8691 (AGARD-AG—311, pp 55-98) **Algorithm and general software considerations.** Neves, K.W. Mar 1988. NTIS, PC A09/MF A01.

In Computational fluid dynamics: algorithms and supercomputers.

This chapter of the study examines the relationship between hardware architecture and computational performance. The setting is scientific computation of a generic sense (i.e., application nonspecific). In subsequent chapters, the general implications discussed here will be applied to algorithms specific to computational fluid dynamics and to the major computational approaches used in that field. In order to give meaningful appreciation of the concepts discussed, frequent use of examples on specific hardware architectures will be utilized. Quite often several machine types will be included, and several will not. The reasons for this are twofold: (1) it is not always possible to obtain exactly the same benchmark results across machine types, and (2) it is not our intent to give a definitive comparison of machine performance. These reasons may seem superficial at first glance, yet thay are fundamental to the reality of the state-of-the-art of computer metrics.

8692 (AGARD-AG—311, pp 7) **Informal glossary of terms used in supercomputing, appendix A.** Neves, K. Mar 1988. NTIS, PC A09/MF A01.

In Computational fluid dynamics: algorithms and supercomputers.

This informal glossary associated with supercomputers evolved casually. The primary draft was made in 1986 by the IEEE Subcommittee on Supercomputing. In addition, terms have been added and revised. Any rapidly advancing field generates its own new terminology. The new terms arise by applying new meanings to older terms as well as through the coining of new terminology. The process is dynamic and often results in dual meanings of commonly used words and sometimes just plain fuzzy definitions. Nevertheless, it is believed that this tabulation will: (1) help both novices and experts to better communicate, and (2) provide input to more formal dictionary/definition writing processes.

8693 (AGARD-CP—422, pp 13) **Analysis of the flow through double swirl airblast atomizers.** Bluemcke, E.; Eickhoff, H.; Hassa, C.; Koopman, J. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The flow field resulting from a counterswirl airblast atomizer was investigated numerically and experimentally. The flow pattern shows the typical features of a swirling flow with an inner recirculation zone. Comparison of calculated results with experimental data shows that general features of the flow can be predicted with reasonable accuracy. The propagation of the spray downstream from the atomizer was investigated theoretically using a deterministic flow model for the liquid phase. The predictions demonstrate the influence of operating conditions on the spray characteristics.

8694 **(CEA-R—5461) Study of aerosol behaviour in an acoustic field.** Malherbe, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). 1988. 167p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755998/JAW.

The average size of an aerosol submitted to acoustic waves is increased. This results from coagulation of the finer particles on the larger ones. An experimental apparatus was developed in order to control the evolution of aerosol distribution in an acoustic field. Important deposition on the walls of the agglomeration chamber was observed as a consequence of the acoustically induced turbulent flow. Consequently, we experimentally evaluated the turbulent properties of the system. A granular bed submitted to an acoustic field and set downstream an agglomerator constitutes an almost absolute filter for an usually penetrating aerosol.

8695 **(CEA-tr—2283) Calculation of mass transfer in sodium thermic tubes.** Ivanov, V.A.; Levchenko, V.E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1987. 18p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755999/JAW.

On the basis of the known theoretical and experimental data on structural material solubility in liquid sodium, as well as physical peculiarities of heat tube operation, the methods for the calculation of mass transfer of sodium dissolved components of vessel materials and capillary porous structure are developed. It has been shown for the first time that the dissolving of structural materials and their deposition take place irregularly over the length of the heat tube. It is found, that with heat tube capacity increase the cross section with the maximum amount of deposited mass shifts to the evaporation zone start. It is shown, that dissolution rate of structural materials in condensor zone of the heat tube increases along the direction of liquid sodium motion in it. Calculation results of sodium heat tube operation life are presented and its dependence on the flow rate transferred by the tube is shown.

8696 **(CEA-tr—2292) Effective properties of heterogeneous media with free undeformable inclusions under the action of vibrations.** Fedotovskii, V.S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756001/JAW.

In this paper the authors present the study on the dynamic behavior of heterogeneous media formed by newtonian liquids and undeformable inclusions under the action of vibrations on the liquid. Minor one-dimensional forward vibrations of heterogeneous media and their effective properties (translatory density and viscosity) corresponding with this type of motion were considered. The effective properties determine the dynamic characteristics of vibrational systems contacting with the heterogeneous media. Particular types of heterogeneous media with spherical and cylindrical inclusions simulating two-phase bubble media and rod assemblies submerged in the liquid were considered. The ultimate cases with light and heavy inclusions giving the most typical dependences of the effective properties of heterogeneous media on the properties of phases forming them were analyzed.

8697 **(CEA-tr—2293) Continual approach to the dynamics problems of tanks containing rod bundles or particle groups and fluid at vibrational actions.** Fedotovskii, V.S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 47p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756002/JAW.

The vibration of tanks with liquid and non deformed cylindrical or spherical inclusions are considered. It is shown that for calculating dynamic characteristics of such systems it is advisable to use continual approach i.e. consider-heterogeneous media formed by liquid and weighted inclusions in it as homogeneous media with effective or vibroreological properties. On the base of the problem on vibrations of the tank, containing liquid and localized inclusions, rod assemblies vibrations are considered and relationships for the added mass and resistance coefficient determining dynamic charac-

teristics of such systems are obtained. Considered are also liquid tank vibrations containing spherical inclusions. The results obtained are used for calculating dynamic characteristics of two-phase flow pipelines at bubble and annular flow mode. The theoretical relationships are compared with available experimental data.

8698 **(ENEA-RT-TERM—88-1) Comprehensive analysis of direct contact condensation of saturated steam on subcooled liquid jets.** Celata, G.P.; Cumo, M.; Farello, G.E.; Focardi, G. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 62p. NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE88704901/JAW.

An experiment on direct contact condensation of saturated steam on subcooled liquid jets was performed together with a theoretical analysis of the experimental data. Correlations available in literature are generally unable to predict both the local conditions of the liquid jet and the total heat transfer. From the analysis of the local and global fluid-dynamics effects, a calculation method based on an equivalent thermal conductivity of the liquid jet has been proposed. The comparison with the experimental data looks acceptable and well within the experimental accuracy. 24 figs.

8699 **(JINR—8-87-708) Universal device for thermophysical experiments in a helium Dewar flask.** Velichkov, I.V.; Datskov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704829/JAW.

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The construction of a device for thermophysical experiments and measurement of the thermal conductivity are described. The cryostat if 39mm in diameter, designed as an insert for a helium Dewar flask. The insert is equipped with quick-diassembling low-temperature vacuum seal, constructed as a lapped taper surface connection of a stainless steel parts. An express method for measuring the thermal conductivity using this insert is described. In the temperature interval from 5 K to 13K thermal conductivities of the stainless steel 12x18H10T, of electrical steel E-310, the epoxy adhesive EG-80, silicate glue with fillers are measured 2% absolute error for the method is estimated. 10 refs.; 6 figs.

8700 **(N—88-29106) Numerical investigations in three-dimensional internal flows. Semiannual status report, 1 October 1987-31 March 1988.** Rose, W.C. (Nevada Univ., Reno (USA)). Aug 1988. 13p. (NASA-CR—183108; NAS—1.26:183108). NTIS, PC A03/MF A01.

An investigation into the use of computational fluid dynamics (CFD) was performed to examine the expected heat transfer rates that will occur within the NASA-Ames 100 megawatt arc heater nozzle. This nozzle was tentatively designed and identified to provide research for a directly connected combustion experiment specifically related to the National Aerospace Plane Program (NASP) aircraft, and is expected to simulate the flow field entering the combustor section. It was found that extremely fine grids, that is very small mesh spacing near the wall, are required to accurately model the heat transfer process and, in fact, must contain a point within the laminar sublayer if results are to be taken directly from a numerical simulation code. In the present study, an alternative to this very fine mesh and its attendant increase in computational time was invoked and is based on a wall-function method. It was shown that solutions could be obtained that give accurate indications of surface heat transfer rate throughout the nozzle in approximately 1/100 of the computer time required to do the simulation directly without the use of the wall-function implementation. Finally, a maximum heating value in the throat region of the proposed slit nozzle for the 100 megawatt arc heater was shown to be approximately 6 MW per square meter.

8701 **(N—88-29115) Adaptive computational methods for aerothermal heating analysis. Final contractor report, September 1984-December 1987.** Price, J.M.; Oden, J.T. (Lockheed Missiles and Space Co., Huntsville, AL (USA)). May 1988. 227p. (NASA-CR—181636; NAS—1.26:181636; LMSC-HEC-TR-F—225772). NTIS, PC A11/MF A01.

The development of adaptive gridding techniques for finite-element analysis of fluid dynamics equations is described. The developmental work was done with the Euler equations with concentration on shock and inviscid flow field capturing. Ultimately this methodology is to be applied to a viscous analysis for the purpose of predicting accurate aerothermal loads on complex shapes subjected to high speed flow environments. The development of local error estimate strategies as a basis for refinement strategies is discussed, as well as the refinement strategies themselves. The application of the strategies to triangular elements and a finite-element flux-corrected-transport numerical scheme are presented. The implementation of these strategies in the GIM/PAGE code for 2-D and 3-D applications is documented and demonstrated.

8702 **(N—88-30063) User's manual for three dimensional boundary layer (BL3-D) code. Final report.** Anderson, O.L.; Caplin, B. (United Technologies Research Center, East Hartford, CT (USA)). Aug 1985. 143p. (NASA-CR—174899; NAS—1.26:174899; R—85-956834-1). NTIS, PC A07/MF A01.

An assessment has been made of the applicability of a 3-D boundary layer analysis to the calculation of heat transfer, total pressure losses, and streamline flow patterns on the surface of both stationary and rotating turbine passages. In support of this effort, an analysis has been developed to calculate a general nonorthogonal surface coordinate system for arbitrary 3-D surfaces and also to calculate the boundary layer edge conditions for compressible flow using the surface Euler equations and experimental data to calibrate the method, calculations are presented for the pressure endwall, and suction surfaces of a stationary cascade and for the pressure surface of a rotating turbine blade. The results strongly indicate that the 3-D boundary layer analysis can give good predictions of the flow field, loss, and heat transfer on the pressure, suction, and endwall surface of a gas turbine passage.

8703 **(N—88-30066) Assessment of a 3-D boundary layer analysis to predict heat transfer and flow field in a turbine passage. Final analysis report.** Anderson, O.L. (United Technologies Research Center, East Hartford, CT (USA)). Aug 1985. 93p. (NASA-CR—174894; NAS—1.26:174894; R—85-956834). NTIS, PC A05/MF A01.

An assessment was made of the applicability of a three dimensional boundary layer analysis of heat transfer, total pressure losses, and streamline flow patterns on the surfaces of both stationary and rotating turbine passages. In support of this effort, an analysis was developed to calculate a general nonorthogonal surface coordinate system for arbitrary three dimensional surfaces and also to calculate the boundary layer edge conditions for compressible flow using the surface Euler equations and experimental pressure distributions. Calculations are presented for the pressure, endwall, and suction surfaces of a stationary cascade and for the pressure surface of a rotating turbine blade. The results strongly indicate that the three dimensional boundary layer analysis can give good predictions of the flow field, loss, and heat transfer on the pressure, suction, and endwall surface of a gas turbine passage.

8704 **(N—88-30071) Analysis of finite-difference and finite-volume formulations of conservation laws. Final technical report.** Vinokur, M. (Sterling Software, Palo Alto, CA (USA)). Jun 1986. 60p. (NASA-CR—177416; NAS—1.26:177416). NTIS, PC A04/MF A01.

Finite-difference and finite-volume formulations are analyzed in order to clear up the confusion concerning their application to the numerical solution of conservation laws. A new coordinate-free formulation of systems of conservation laws is developed, which clearly distinguishes the role of physical vectors from that of algebraic vectors which characterize the system. The analysis considers general types of equations--potential, Euler, and Navier-Stokes. Three-dimensional unsteady flows with time-varying grids are described using a single, consistent nomeclature for both formulations. Grid motion due to a non-inertial reference frame as well as flow adaptation is covered. In comparing the two formulations, it is found useful to distinguish between differences in numerical methods and differences in grid definition. The former plays a role for non-Cartesian grids, and results in only cosmetic differences in the manner in which geometric terms are handled. The differences in grid definition for the two formulations is found to be more impor-

tant, since it affects the manner in which boundary conditions, zonal procedures, and grid singularities are handled at computational boundaries. The proper interpretation of strong and weak conservation-law forms for quasi-one-dimensional and axisymmetric flows is brought out.

8705 **(N—88-30076) Transition mixing study empirical model report, September 1986-January 1988.** Srinivasan, R.; White, C. (Garrett Engine Co., Phoenix, AZ (USA)). Feb 1988. 126p. (NASA-CR—182139; NAS—1.26:182139; GARRETT—21-6689). NTIS, PC A07/MF A01.

The empirical model developed in the NASA Dilution Jet Mixing Program has been extended to include the curvature effects of transition liners. This extension is based on the results of a 3-D numerical model generated under this contract. The empirical model results agree well with the numerical model results for all tests cases evaluated. The empirical model shows faster mixing rates compared to the numerical model. Both models show drift of jets toward the inner wall of a turning duct. The structure of the jets from the inner wall does not exhibit the familiar kidney-shaped structures observed for the outer wall jets or for jets injected in rectangular ducts.

8706 **(N—88-30099) Measurement of local high-level, transient surface heat flux.** Liebert, C.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1988. 9p. (NASA-TP—2840; E—4200; NAS—1.60:2840). NTIS, PC A02/MF A01.

This study is part of a continuing investigation to develop methods for measuring local transient surface heat flux. A method is presented for simultaneous measurements of dual heat fluxes at a surface location by considering the heat flux as a separate function of heat stored and heat conducted within a heat flux gage. Surface heat flux information is obtained from transient temperature measurements taken at points within the gage. Heat flux was determined over a range of 4 to 22 MW/sq m. It was concluded that the method is feasible. Possible applications are for heat flux measurements on the turbine blade surfaces of space shuttle main engine turbopumps and on the component surfaces of rocket and advanced gas turbine engines and for testing sensors in heat flux gage calibrators.

8707 **(N—88-30384) Nonequilibrium flow computations. 1. An analysis of numerical formulations of conservation laws.** Liu, Y.; Vinokur, M. (Sterling Federal Systems, Inc., Palo Alto, CA (USA)). Jun 1988. 29p. (NASA-CR—177489; NAS—1.26:177489). NTIS, PC A03/MF A01.

Modern numerical techniques employing properties of flux Jacobian matrices are extended to general, nonequilibrium flows. Generalizations of the Beam-Warming scheme, Steger-Warming and van Leer Flux-vector splittings, and Roe's approximate Riemann solver are presented for 3-D, time-varying grids. The analysis is based on a thermodynamic model that includes the most general thermal and chemical nonequilibrium flow of an arbitrary gas. Various special cases are also discussed.

8708 **(NAL-SP—8) Special publication of national aerospace laboratory. Transactions of the 5th. aero-computing aerodynamics symposium.** Miyoshi, Hajime; Fukuda, Masahiro; Takanashi, Susumu; Fujii, Kozo. (National Aerospace Lab., Chofu, Tokyo (Japan)). Nov 1987. 257p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755746/JAW.

This is a table of contents of the symposium held in Nov. of 1987. Reports contained are as follows: On the NAL Numerical Simulator System. Numerical simulations of Aerodynamical Contribution of Flow about a Space-plane-type Configuration. Numerical simulations of Flow around Shuttlie Orbiter. Finite Element Analysis of Incompressible Viscous Flow around Multi--Element Aerofoils. Numerical Simulations of Astrophysical Jets. Numerical Calculation of Supersonic Flow by the PNS Equations. Navier-Stokes Analysis of Tranaonic Transport Aircraft Empennage. Numerical Solutions of the Euler Equations forthe Flow Field Around Counter-Rotating Propellers. Numerical Simulation of Ultrasonic Free Jet Stream. Computation of Flow around NACA 012 Airfoil at High Angle of Attack. Other 27 reports.

8709 **(PB—89-102792/XAB) Turbulent-flow characterization and radiation from gaseous fuel jets. final report, April 1985-October 1987.** Delichatsios, M.A.; Markstein, G.H.; Orloff, L.; de Ris, J. (Factory Mutual Research Corp., Norwood, MA (USA)). 1987. 146p. NTIS, PC A07/MF A01.

See also PB—88-107990.

Methods for increasing and predicting the radiant output from turbulent-diffusion flames were studied in order to improve the design and increase the efficiency of industrial gas burners and furnaces. The effects of the thermochemical parameters (i.e. additives, preheating) and the flow field, which both affect flame radiation in turbulent flames, were investigated by measuring smoke-point heights in laminar flames, and correlating these measurements with the radiant-fraction measurements in turbulent diffusion flames over a range covering buoyant to momentum-driven flows. After investigating several additives and preheating conditions, it was found that fuel preheating is the most-promising method to increase soot and flame radiation in natural gas (methane) flames, while keeping nitrogen oxides at low levels.

8710 **(PB—89-107411/XAB) Critical survey of mathematical models for predicting room air movement. Research memo.** Chan, J.K.C.; Scott, D.R. (Polytechnic of the South Bank, London (UK). Inst. of Environmental Engineering). May 1988. 19p. (RM—109). NTIS, PC E04/MF E04.

An overview of some of the mathematical models for predicting room air movement is presented. It shows that there is a need for a simplified model that can be used by air conditioning design engineers.

8711 **(SKI—86087) Prediction of two phase mixture level and cooling conditions during a partial core uncovery.** Andersen, C. (Swedish Nuclear Power Inspectorate, Stockholm; Royal Inst. of Tech., Stockholm (Sweden). Dept. of Nuclear Reactor Engineering). Jan 1988. 37p. (KTH-NEL—44). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755684/JAW.

A model for prediction of the reactor core two phase mixture level, as a function of the downcomer level, has been developed. This model assumes quasi-stationary conditions and is applicable at decay heat levels. Another developed model describes the core uncovery process when no make up water is available. In a third model the heat transfer in the uncovered part of the rod bundle is predicted and the rod temperature, as well as the steam superheat temperature, is calculated as a function of time and elevation. This model can be applied for rod temperatures well above 1200 degrees C. These models have been combined and transferred to a computer code and quantities calculated by this such as axial void distribution, two phase level, and rod temperatures have been compared with test data. Comparisons of two phase level and void distributions show good agreement between test data and calculations, within the observed pressure range of 13 to 70 bar. Comparisons of rod temperatures show that they are underpredicted. This is mainly due to the assumption in the model that the channel wall has the same temperature as the fuel rods. This assumption is not valid for the tests compared with in appendix A, in which the channel box is very oversized compared to reactor conditions. In appendix B comparisons with ASEA-ATOM, DRAGON code calculations show that the present model yields a good representation of the core heat up for typical reactor conditions. A comparison with experimental temperature data from the NEPTUN test facility show generally good agreement for all tests compared with in appendix C.

8712 **Heat losses from underground steam pipelines.** Beck, J.V.; McLain, H.A.; Karnitz, M.A.; Shonder, J.A.; Segan, E.G. (Heat Transfer Group, Michigan State University, Department of Mechanical Engineering, East Lansing, MI). *Journal of Heat Transfer;* **110**: No. 4, 814-820(Nov 1988).

A new transient solution describing the heat transfer around a single buried steam pipe was developed. The solution technique uses Green's functions and is particularly appropriate at distances greater than two or three pipe radii from the pipe. The solution

models the pipe as a line heat source and considers a convective boundary condition at the soil surface. It was shown that for long time periods, the solution reduces to a steady-state expression that is believed to describe heat loss rates better than some current, commonly used steady-state relations. The solution was used with parameter estimation techniques to design an experimental procedure for determining buried steam pipe heat loss rates and depths from near-surface soil temperature measurements. Sensitivity coefficients derived from the solution were used to identify the linearly independent parameters and the optimum locations for the temperature measurements. An example of the use of this procedure is presented.

8713 **Numerical study of turbulent heat transfer in a spherical annulus.** Stein, W.; Brandt, H. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *Journal of Heat Transfer;* **110**: No. 4, 870-876(Nov 1988).

A numerical study of steady, buoyant, incompressible water flow and heat transfer through a spherical annulus has been made. A two-dimensional computer code based on the TEACH code was rewritten in spherical coordinates to model the Navier—Stokes equation and to model fluid turbulence with a k—ϵ turbulence model. Results are given for the total system Nusselt number, local heat transfer rate, and fluid flow characteristics for both buoyant and nonbuoyant laminar and turbulence modeled flow. Incorporating both the turbulence model and buoyancy into the calculations improves the results.

8714 **Wavenumber selection in Benard convection.** Catton, I. (Mechanical, Aerospace and Nuclear Engineering Department, University of California, Los Angeles, CA 90024-1597). *Journal of Heat Transfer;* **110**: No. 4, 1154-1165(Nov 1988).

The results of three related studies dealing with wavenumber selection in Rayleigh—Benard convection are reported. The first, an extension of the power integral method, is used to argue for the existence of multi-wavenumbers at all supercritical wavenumbers. Most existing closure schemes are shown to be inadequate. A thermodynamic stability criterion is shown to give reasonable results but requires empirical measurement of one parameter for closure. The third study uses an asymptotic approach based in part on geometric considerations and requires no empiricism to obtain good predictions of the wavenumber. These predictions, however, can only be used for certain planforms of convection.

8715 **(N—88-29134) Shock waves in unsteady flows.** Tavera, G.; Burnage, H. (National Aeronautics and Space Administration, Washington, DC (USA)). Sep 1988. Transl. into ENGLISH from Sur les Ondes de Choc Dans les Ecoulements Instationnaires, Academie des Sciences (Paris, France), Comptes Rendus, Serie A-Sciences Mathematiques, Vol. 284, No. 10, 571-573(7 Mar 1977). (NASA-TT—20329; NAS—1.77:20329). 7p. NTIS, PC A02/MF A01.

The space-time motion of a shock wave in an unsteady flow is taken into account by a kinematic description. The space is divided into an upstream and a downstream region, and the shock is replaced by an equivalent distribution of mass, momentum, and energy sources, all expressed as functions of the upstream quantities and the motion of the shock. The result can be seen as an application of Huygens principle to the problem of the interaction between a shock wave and an unsteady flow.

8716 **(N—88-29041) Reaction-theoretical aspects of the thermal behavior of lubricating oils and working fluids.** Schulze, K.W. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1988. Transl. into ENGLISH from Schmierungstechnik (Fed. Republic of Germany), Vol. 17, No. 10, 308-311(1986). (NASA-TT—20304; NAS—1.77:20304). 23p. NTIS, PC A03/MF A01.

A portion of a review with 19 references of the principles and kinetic aspects of the thermal stability of lubricating oil and working fluids is presented. The thermal stabilization of various organic compounds in gaseous and liquid phases is examined, especially with regard to structure.

8717 **(N—89-10262) Thermal transfer recording media.** Takei, T.; Taniguchi, M.; Fukushima, H.; Yamaguchi, Y.; Shinozuka, M.; Seikohsha, K.K.S. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1988. Transl. into ENGLISH of Japanese Patent No. SHO-62-87074, 437-440(7 Oct 1985). (NASA-TT—20322; NAS—1.77:20322). 11p. NTIS, PC A03/MF A01.

The recording media consist of more than or one coloring layer and a layer containing a flame retardant to ensure noncombustibility and good thermal transfer. Thus, a PET film was coated on a side with a compound containing Vylon 290 (polyester resin), AFR-1021 (decabromodiphenyl oxide) 8 and Polysafe 60 (Sb oxide), and coated on the other side with a compound containing carnauba wax, HNP-9 (paraffin wax), EV-410 (ethylene-vinyl acetate copolymer), and Cu phthalocyanine to give a thermal transfer recording medium which showed good noncombustibility and antiblocking properties, and provided high quality images.

8718 **Tutorial on elementary bifurcation theory.** Romero, L.A. (Sandia National Labs., Albuquerque, NM (US)). pp 1-10 of Bifurcation phenomena in thermal processes and convection. Bau, H.H.; Bertram, L.A.; Korpela, S.A. New York, NY; American Society of Mechanical Engineers (1988). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

In this paper the authors present the main results from elementary bifurcation theory. The subject matter can be mastered by anyone with a good undergraduate training in engineering mathematics. The mathematics is simple, yet it can be of enormous use when approaching a nonlinear problem.

8719 **Successive transition of steady states in moderate size containers of air heated below and cooled above.** Leith, J.R. (Dept. of Mechanical Engineering, Univ. of New Mexico, Albuquerque, NM (US)). pp 91-98 of Bifurcation phenomena in thermal processes and convection. Bau, H.H.; Bertram, L.A.; Korpela, S.A. New York, NY; American Society of Mechanical Engineers (1988). (CONF-871234—).

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Transition of steady states (inverted bifurcation) is evaluated empirically for thermal convection of air in moderate size containers. Flow structure evolution with increasing Rayleigh number is defined by successive loss of individual convection rolls, following an initial pattern formation at the onset of convection of square longitudinal rolls parallel to the shorter side of the container. Results are reported for 12 x 4 x 1, 11 x 4 x 1, 10 x 4 x 1, 9 x 4 x 1, and 8 x 3 x 1 geometries, in which the transitions of convection roll patterns are determined from evolutionary experiments. The net result is a wavenumber-Rayleigh number description for the geometries, which can be used for further evaluation of transition to chaotic behavior.

## 4205 Materials Testing

*REFER ALSO TO CITATION(S) 8118, 8119, 8612, 8617, 10526*

8720 **(AD-A—198335/2/XAB) Detection of fuze defects by image-processing methods.** Chung, M.J. (Materials Research Labs., Ascot Vale (Australia)). Mar 1988. 27p. (MRL-R—1109). NTIS, PC A03/MF A01.

This paper describes experimental studies of the detection of mechanical defects by the application of computer-processing methods to real-time radiographic images of fuze assemblies. The experimental results confirm that a new algorithm developed at Materials Research Laboratory has potential for the automatic inspection of these assemblies and of others that contain discrete components. The algorithm was applied to images that contain a range of grey levels and has been found to be tolerant to image variations encountered under simulated production conditions.

8721 (INIS-SU—61/A, pp 65-67) **Operational experience of installations for testing fuel distribution in fuel elements.** Voronin, V.A.; Gaev, V.P.; Gneushev, V.N.; Dvoretskij, V.G.; Ivanov, V.B. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780031/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(34).

In Radiation technique. Scientific-technical collection.

Operating experience of three facilities designed for control of distribution of fuel and its components along the fuel element length is generalized. Fuel component control facilities operated during 6 years, AKORT-1-4, AKORT-2- during 2 years. The gamma-scanning method was applied for control of all the facilities. Plutonium distribution was tested by characteristic radiation of the fuel element, distribution of fuel composition density was controlled by weakening the translucent radiation. Design peculiarities, advantages and shortcomings of each facility are considered. The main principles, which should be taken into account when designing similar facilities, are formulated. 2 refs.

8722 **(IS-M—607) An automated multiviewing ultrasonic technique for flaw reconstruction.** Thompson, D.O.; Hsu, D.K.; Wormley, S.J. (Ames Lab., IA (USA)). 1987. Contract W-7405-ENG-82. 16p. (CONF-870679—5). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003733/JAW.

From 5. symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

This paper describes key achievements in the development of an automated multiviewing ultrasonic instrumentation for flaw characterization in materials. Based on ultrasonic signals scattered from the flaw in a number of directions, the signal processing algorithms provide a reconstruction of the size, shape, and orientation of the flaw. To improve the reconstruction reliability for arbitrarily oriented flaws, an angular scan plan is developed to select the most favorable data acquisition aperture configuration for a given flaw. Reconstruction results are presented. Electronic circuits are developed for the generation and detection of broadband unipolar ultrasonic pulses in order to characterize flaws over a wider size range. A second generation multiview transducer has been developed to incorporate these capabilities. The instrumentation and the associated signal processing algorithms form a unique research and inspection tool. 17 refs., 6 figs., 1 tab.

8723 **(JAERI-M—88-169) Development of high temperature tube bending apparatus.** Kaji, Yoshiyuki; Kikuchi, Kenji; Muto, Yasushi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1988. 43p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756062/JAW.

Heat transfer tubes of an intermediate heat exchanger (IHX) in the High Temperature Engineering Test Reactor (HTTR) are subjected to thermal stresses due to a restriction of thermal expansion during start-up and shut-down transients. This results in the low-cycle fatigue damage, which determines their structural lives. A safety margine for the structural life of heat transfer tubes should be ascertained because they belong to the important pressure boundary for the reactor coolant. In addition, there might be some difference between the strengths of tubes and those of solid bar test specimens, which are generally used, by the differences of dimension, manufacturing history and stress state. Then, the authors developed a high temperature tube bending test apparatus which enables a high temperature fatigue test of the heat transfer tube by a four point bending method and carried out room temperature test, preliminary high temperature tests and analysis to examine the performance of test apparatus. The results obtained are summarized as follows. (1) As results of the test at room temperature, it was found that axial strain of tube specimen was constant over its length and axial force of tube specimen was negligible. And in an elastic region, the measured values corresponded to the analytical values. (2) As results of the temperature distribution test, it was found that the temperature was kept constant within +-2 {similar←to} 3 deg C over the range of 50 mm from middle of the tube specimen. (3) As results of the high temperature fatigue test, the bending fatigue life for the tube specimen was seemed to be lower than the tension-compression fatigue life for the solid bar specimen.

8724 **(KCP—613-4033) Investigation of materials and bonding using the scanning laser acoustic microscope: Final report.** Jones, B.A.; Boehning, C.W. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Dec 1988. Contract AC04-76DP00613. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004435/JAW.

The Scanning Laser Acoustic Microscope (SLAM) is a relatively new instrument which uses properties of acoustic wave propagation to examine various material samples. Internal defects such as cracks, delaminations, voids, and inclusions can be detected nondestructively and on a real-time basis. For this reason, the SLAM system may serve as a potential replacement in situations that now call for destructive physical analysis. A considerable amount of training is necessary to enable a prospective SLAM operator to understand the complete system operation and capabilities. In addition, a considerable amount of experience is needed for an operator to evaluate the results obtained. However, with enough training and experience, a SLAM operator can identify a variety of defects; these would include defective hermetic seals on leadless hermetic packages, voids or delaminations in cermaic chip capacitors, incomplete die attachment to chip carriers, and cracks in Mn-Zn ferrites. 4 refs., 12 figs., 1 tab.

8725 **(TTI—8710) Acoustic emission monitoring system for welding thick-walled vessels. Final report.** (Tektrend International, Inc., Montreal, Quebec (Canada)). 1987. 9p. (MICROLOG—88-01559). Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This project was undertaken to apply advanced computer methods, in combination with the previously developed SLAM (Signal Location and Acquisition Module) data acquisition hardware, to on-line industrial weld monitoring. Using shop tests, methods were developed to apply pattern recognition to acoustic emission (AE) source identification, in order to reduce background and process noise problems and to provide a more powerful real time AE signal location and acquisition program that addresses and accomodates the industrial welding process environment. The ability to identify and classify process noises was demonstrated, as was the use of AE as a routine inspection method.

8726 **(UCRL—98889) Structural verification using modal frequency testing: A nondestructive evaluation.** Drouillard, T.F.; Ikle, D.N.; Gustaveson, D.K. (Lawrence Livermore National Lab., CA (USA)). 30 Nov 1988. Contract W-7405-ENG-48. 24p. (CONF-881076—11). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004163/JAW.

From 59. shock and vibration symposium; Albuquerque, NM, USA (18 Oct 1988).

An investigation was carried out to study the application of modal frequency testing as a nondestructive method for structural verification and bond characterization of a dissimilar-metal structure joined by solid-state bonding. Important to the success of this investigation were the contributions from three disciplines: nondestructive evaluation, experimental modal analysis, and statistical analysis. This interdisciplinary effort resulted in a unique concept of structural verification{endash}the use of modal frequency testing to determine the geometrical consistency of precision parts and to characterize the condition of the silver solid-state bonds in a beryllium/stainless steel structure during its manufacture. Two methods of data analysis will be presented: one is an overlay of frequency response measurements to observe macro effects, and the other is principal component analysis of modal parameters to distinguish micro effects. The sensitivity of modal testing to small changes in the mass of a structure will also be discussed. 12 refs., 23 figs.

8727 **(UCRL—99761) A comparison of finite element analysis with neutron and x-ray measurements of residual strains in stainless steel.** Flower, E.C.; MacEwen, S.R.; Holden, T.M.; Hosbons, R.R. (Lawrence Livermore National Lab., CA (USA)). 3 Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-8811111—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002880/JAW.

From International conference on residual stresses-2; Nancy, France (23 Nov 1988).

The objective of the present work was to compare calculations of residual strain in a steel ring deformed under diametral loading in compression with bulk measurements made with neutron diffraction and surface measurements made with x-rays. Numerical analysis, carried out at LLNL using the NIKE finite element codes, showed that the distribution of residual strain at the four 90{degree} positions of the ring were as expected for a plastically-bent plate. The sample had been designed initially to give plane stress conditions during deformation, and this result was confirmed by comparing calculations from NIKE2D and NIKE3D. Neutron diffraction measurements were made using the (111) and (002) diffraction lines. Both sets of results clearly delineated the elastic-plastic boundaries and the elastic core of the sample. However, because of the elastic anisotropy of the steel, the strains measured with (002) were greater, and those measured with (111) were less than predicted by the NIKE analysis. X-ray diffraction measurements were made with the (420) diffraction line, in order to obtain peaks at high backscattering angles. Results were in reasonable agreement with the NIKE calculations. The data will be discussed in terms of the choice of diffraction line and the elastic anisotropy of stainless steel. 4 refs., 5 figs.

8728 **Study of supported platinum catalysts by anomalous scattering.** Georgopoulos, P.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA)). *Journal of Catalysis;* **92**: 211-215(1985).

Platinum metal catalysts supported on silica gel and alumina were examined by wide-angle anomalous x-ray scattering at the Cornell High Energy Synchrotron Source. Complete removal of the support background features is achieved by this method, eliminating errors due to inaccurate background estimation. Platinum diffraction patterns from very-high-percentage metal-exposed catalysts were obtained for the first time, as well as from platinum supported on alumina. This technique is suitable for examining catalysts under working conditions and is superior to EXAFS for determinations of particle morphology and size distribution. 10 references, 8 figures.

## 4208 Electronic Circuits And Devices

*REFER ALSO TO CITATION(S) 7608, 8354, 8358, 8359, 8363, 8365, 8659, 8674, 8675, 9087, 9101, 9107, 9127, 10342, 10543*

8729 **(AD-A—197070/6/XAB) Electro-optical devices. Annual report, 1 October 1982-30 September 1983.** Tsang, D.Z.; Williamson, R.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Sep 1983. 45p. NTIS, PC A03/MF A01.

A mass-transport phenomenon was utilized to achieve GaInAsP/InP buried-heterostructure (BH) lasers. This novel technique is considerably simpler and more easily controlled than those previously reported, and has resulted in BH lasers with threshold currents as low as 9.0 mA. The technology for fabricating laser diodes, detectors, and optical waveguides in GaInAsP/InP epitaxial wafers requires the use of suitable etching techniques for providing smooth, damage-free surfaces of precision-pattern geometries and for the preferential and reproducible removal of specific layers. It was found that a 1 H(2)SO(4):1 H(2)O(2):10 H(2)O room-temperature solution etches (100) Ga(0.27)In(0.73)As(0.03)P(0.37) (lambda = 1.3 micron) at a very constant etch rate of 1000 A/min. Other ratios of H(2)SO(4):H(2)O(2):H(2)O should prove useful as slow selective etches for GaInAsP in a variety of applications. Three-guide optical couplers consisting of slab-coupled rib-type guides were fabricated on GaAs. Their behavior closely approximates that predicted using an effective-index analytic method. Couplers of this type should prove useful as replacements for Y-type power dividers and combiners, especially in cases where waveguide bends would result in unacceptable losses. GaInAsP diode lasers with a proton-isolated modulator were operated with full on/off modulation at rates of 3 GHz. Both the gain and loss are actively varied in the modulator in order to Q-switch the laser.

8730 **(AD-A—197119/1/XAB) Topical meeting on optics in adverse environments: summaries of papers presented at the Optics in Adverse Environments Topical Meeting held in Albuquerque, New Mexico on 11-12 February 1987. Technical Digest series. Volume 8. Final report, 1 January-31 October 1987.** Quinn, J.W. (Optical Society of America, Washington, DC). 31 Oct 1987. 102p. NTIS, PC A06/MF A01.

Summaries are presented of the following papers: Environmental Impacts on the Hubble Space Telescope; Ultralightweight Optics in a Cryogenic Environment; Learjet Observatory Operations in The Tropics; Advanced Optics Fabrication Trends; Materials for Space Optics; Optical Fabrication Using Ion-Beam Figuring; Optics for the Free-Electron-Laser; All-Metal Resonator Design for Visible/Near IR Free-Electron-Laser Oscillators; Cooled Optics for High-Powered Laser Applications; Impinged-Droplet Evaporative Cooling for Optical mirrors Subjected to High Thermal Flux Loads; Radiation Effects in Optical Components; Gamma Radiation-Induced Absorptions in Calcium Fluoride; Variation of the Index of Refraction in Glasses Exposed to Ionizing Radiation; Radiation Damage to Dielectric Mirrors; Effect of Surface Pitting on Scattered Light in Transparent Domes; High-Damage-Threshold Optical Coatings; Fluorine Resistance of Dielectric Coatings for Excimer-Laser Optics; Porous Halide Antireflective Coatings for Adverse Environments; Auger Analysis of Elemental Depth Profiles Correlated with Multipulse Laser Damage of GaAs Surfaces; and Compressive Coatings on Optical Components for Improving Mechanical Durability and Increasing Strength.

8731 **(AD-A—197849/3/XAB) EMP (electromagnetic pulse) mitigation program approach. Final report.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 10 Sep 1987. 82p. NTIS, PC A05/MF A01.

The function of the EMP Mitigation Program is to assess, and where possible, lessen the potential adverse effects of electromagnetic pulse (EMP) on the nation's telecommunications infrastructure. The Office of the Manager, National Communications System (OMNCS) focuses its efforts on the Public Switched Network (PSN) because the majority of critical government users rely on the PSN to conduct their National Security Emergency Preparedness (NSEP) communication requirements. This document presents an overall plan for the EMP Mitigation Program. To date, the OMNCS has a series of tools for quantifying EMP effects on the PSN. These tools include models for predicting the effect of EMP on network equipment and estimating the EMP stress levels that equipment are exposed to. Also available is a data base for describing the topology of a major portion of the post-divestiture PSN. Results of these activities are then synthesized into a network level model, whose function is to evaluate the performance capabilities of the MEP exposed network. In addition the network-level model has the ability to perform sensitivity studies. Sensitivity studies can assess the importance of different equipment types, and they are therefore useful for identifying which equipment types are require EMP testing. Present plans call for testing of the Northern Telecom DMS-100 and AT&T 4ESS switches.

8732 **(NYSERDA—88-11) Development of a high-speed ac adjustable-speed motor: Final report.** (New York State Energy Research and Development Authority, Albany (USA); R E M Technologies, Inc., Albany, NY (USA)). Oct 1988. 61p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89004090/JAW.

A prototype high-speed inverter and motor has been built and tested. This high-speed drive comprises three major components: a high-speed motor which has a one-piece rotor and no rotating windings, permanent magnets or brushes; a high-frequency transistor inverter; and a controller which maintains the speed of the drive. This drive operates from 0 to 50,000 RPM and can develop up to 6 ft*lbs of torque. Engineering performance data under load is measured to calibrate a computer design program. Performance data includes such measurements as efficiency, power factor, horsepower, temperature rise, and noise. The unique machine arrangement required that a specific electromagnetic design program be

developed to accurately size the machine and evaluate its performance. The design program was written in Fortran. The program includes all of the geometry and electromagnetic parameters necessary to calculate the horsepower, torque, temperature rise, efficiency, and other design variables usually computed in motor design. 2 refs., 23 figs., 5 tabs.

8733 **(PB—89-107544/XAB) CMOS process technology.** Komori, T.; Nishizawa, M.; Sato, Y. (Fuji Electric Co. Ltd., Tokyo (Japan)). 1988. 4p. NTIS, PC E06/MF A01.

Text in Japanese; Included in Fuji Electric Jnl., Vol. 61, No. 7, 445-447(1988).

This paper introduces an outline of silicon-gate CMOS process technology from among Fuji Electric's custom IC technologies. Particularly described are the features, process flows, and device characteristics of 6-micrometer CMOS technology having realized about 40V breakdown voltage, bump application, and a built-in photosensor system, as well as of Fuji Electric's original 2-micrometer CMOS process technology.

8734 **(PB—89-850184/XAB) Fiber-optic communication systems and equipment. November 1986-October 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for November 1986-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 61p. NTIS PC N01/MF N01.

Supersedes PB—87-868923.

This bibliography contains citations concerning fiber-optic communication systems and equipment. Topics include fiber strength, microbend effects, radiation effects, fiber systems, optical fiber cables, fiber manufacturing, computer networks, couplers and connectors, AM sources, detectors and switches, fiber design, modal noise, splicing cables, and data networks. (This updated bibliography contains 108 citations, 52 of which are new entries to the previous edition.)

8735 **(SAND—88-1765C) A comparison of fixed-base and driven-base modal testing of an electronics package.** Carne, T.G.; Martinez, D.R.; Nord, A.R. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 9p. (CONF-890152—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002364/JAW.

From 7. IMAC conference; Las Vegas, NV, USA (30 Jan 1989).

This paper compares results for a fixed-base and a driven-base modal test of an electronics package. A fixed-base modal test uses the common testing procedure of attaching the structure to a large inertial mass which is freely suspended. The problem with this approach is that the input levels are typically limited by the size of the shakers and the strength of the attachment. An attractive alternative to fixed-base modal testing is to use stationary vibration shaker tables to provide a driven-base input. The modes can be obtained at much higher excitation levels than fixed-base excitation modes using portable shakers and flexible attachments. Experimental results are presented which demonstrate the adequacy of using vibration shake tables to excite the fixed-based modes of the system. A direct comparison of the modes acquired using fixed-base and driven-base excitation for the electronics package shows very close agreement. A discussion of the theory for driven-base testing is given, as well as a brief presentation of analytical (finite element) predictions for the structure. 4 refs., 11 figs., 1 tab.

8736 **(SAND—88-7103) Energy loss in magnetic switching cores.** Dougal, R.A. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004427/JAW.

This analytical study had two objectives. The first was to develop a computer code to model, temporally and spatially, the magnetization of amorphous ferrous materials (specifically Metglas) in an inductive circuit element under high surface field conditions while including the interaction of that element with the electrical circuit in a self-consistent manner. The second goal was to partition the energy losses experimentally measured in such a ferrous core according to loss mechanism by making comparisons between the experimental data and the computer simulation. The loss mechanisms considered were eddy current, hysteresis, and other. Experimental data to be compared with the results of the simulation had been previously collected at Los Alamos National Laboratory in the course of a program in which a 1 kHz, three stage magnetic modulator was built. However, inconsistencies in the experimental data became apparent as comparisons were being made between the results of the computer simulation and the LANL data. For this reason, the results in this report have been derived from experimental data supplied by Sandia National Laboratories. A key portion of this work was the development of a computer code to model the magnetization of the ferrous core material. The beginnings of the code had been developed by Howard Rhinehart and Bill Nunnally at Los Alamos, and were written in LASAN, the Los Alamos Systems Analysis language. In the early stages of this project, a great deal of time was spent adapting the LASAN program to run on the VAX computer here at South Carolina. Insufficient documentation proved to be the downfall of these efforts, and later (in retrospect, far to late) we abandoned the idea of running the simulation under LASN, and instead rewrote the simulation in ACSL, a systems simulation code which is supported on our VAX. 18 figs., 1 tab.

8737 **Electro-optic sampling of ultrashort high voltage pulses.** Stearns, D.G. (Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Journal of Applied Physics;* **65**: No. 3, 1308-1316(1 Feb 1989).

High voltage (~1 kV) pulses having 12-ps rise time and a duration of 70 ps have been generated and propagated along a suspended-strip vacuum waveguide. The temporal and spatial profiles of the electric field inside the waveguide have been measured using electro-optic sampling, with resolutions of 10 ps and ~1 mm, respectively. The field is found to be predominantly composed of the TEM/sub 00/ mode, and there is no observable temporal broadening of the ultrashort pulse over a propagation distance of several centimeters. The temporal profile exhibits significant high-frequency modulation which is attributed to the LC resonance of the photoconductive switch.

8738 **Narrow-band microwave generation from an oscillating virtual cathode in a resonant cavity.** Fazio, M.V.; Hoeberling, R.F.; Kinross-Wright, J. (Accelerator Technology Division, Los Alamos National Laboratory, MS-H851, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **65**: No. 3, 1321-1327(1 Feb 1989).

An experimental approach using a high Q, resonant cavity surrounding an oscillating virtual cathode has achieved frequency stabilization, and repeatable narrow-band operation of the virtual cathode microwave source. A cylindrical cavity resonator is used with the microwave power being extracted radially through circumferential slot apertures into dominant-mode L-band waveguide. The electron-beam/cavity interaction produces strong feedback between the induced cavity field and the oscillating virtual cathode, forcing it to lock to the resonant frequency of a cavity mode over a large variation in electron beam current. The 3-dB frequency bandwidth observed during single 100-ns pulses is less than 1%. The 3-dB bandwidth appears to be limited by the finite temporal width of the microwave pulse.

8739 **Simulated behavior of the magnetically insulated oscillator.** Marder, B.M. (Plasma Theory Division 1241, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 3, 1338-1349(1 Feb 1989).

The magnetically insulated oscillator (MILO) is a high-power microwave generating device whose behavior has been investigated experimentally and by numerical simulation. This paper describes MILO operation and its dependence on various parameters as predicted by these simulations. The simulations are compared with both linear theory and experimental data.

8740 **Influence of interfacial contamination on the structure and barrier height of Cr/GaAs Schottky contacts.** Liliental-Weber, Z.; Newman, N.; Washburn, J.; Weber, E.R.; Spicer, W.E. (Department of Material Science and Mineral Engineering, University of California, Berkeley, California 94720 and Center for Advanced Materials, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Applied Physics Letters;* **54**: No. 4, 356-358(23 Jan 1989).

The structure of as-deposited and annealed Cr/GaAs Schottky contacts was investigated by high resolution and analytical electron microscopy. The Schottky barrier height for contacts prepared by cleavage and in situ metallization in ultrahigh vacuum was stable upon annealing up to 370 °C in $N_2$. In contrast, the contacts prepared on air-exposed substrates show an increase of the barrier height by 80 meV during annealing in the same range of temperatures. Comparing these two types of contacts, distinct differences in the grain size, presence of an oxide layer at the interface, and change in stoichiometry in the substrate beneath the contact were detected.

8741 **X-ray imaging of nanostructure patterns.** Vladimirsky, Y.; Kern, D.; Meyer-Ilse, W.; Attwood, D. (Center for x-ray optics, Lawrence Berkley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **54**: No. 3, 286-288(16 Jan 1989).

A Fresnel zone plate lens, with a nominal outer zone width of 400 A, has been used to image nanostructures with soft x-ray synchrotron radiation at 45 A wavelength with the Goettingen x-ray microscope at BESSY in Berlin. The structures, consisting of gold lines in thin silicon nitride membranes, were selected for tests of spatial resolution and image forming capabilities. Several patterns associated with deep submicron electronic circuits were also imaged, showing clearly resolved features smaller than 0.1 μm. Images of periodic structures, including 600 A lines on 2000 A centers, suggest a spatial resolution approaching the theoretical limit of approximately 500 A.

## 4209 Waste Processing Plants And Equipment

8742 **(DOE/CE/30844—H1) Waste-to-energy compendium: Revised 1988 edition.** (Science Applications International Corp., Falls Church, VA (USA); Meridian Corp., Falls Church, VA (USA)). Dec 1988. Contract AC01-83CE30784;AC01-86CE30844. 371p. NTIS, PC A16/MF A01 - OSTI. Order Number DE89004767/JAW.

The Waste-to-Energy Compendium presents detailed profiles of all commercial-scale facilities in the United States that are currently processing municipal solid waste (MSW) to recover energy. This summary of technical, operational, and economic experience at existing plants is intended to serve the community of engineers, consultants, planners, plant operators and maintenance personnel, public and private interest groups, and public officials that will be involved in developing and operating future projects. The Compendium covers only those facilities that were operational as of July 1988, although some of the facilities included may be temporarily shut down for various reasons. Projects under construction or in shake-down were excluded from consideration since operating experience and cost information would not be available. Noncommercial pilot and demonstration facilities and projects that recover methane from sanitary landfills were also excluded. This report is the second update of the Waste-to-Energy Compendium, originally prepared by the National Center for Resource Recovery, Inc., and published by Idaho National Engineering Laboratory in April 1980. A revised edition was prepared by One America, Inc. and published by the US Department of Energy (DOE) in August 1982.

8743 **(PB—89-106058/XAB) National Screening Survey of Hazardous-Waste Treatment, Storage, Disposal, and Recycling Facilities, 1986.** (Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1988. 100p. NTIS, PC A05/MF A01.

See also PB—86-197837.

The report describes the results of the 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (Screening Survey). This survey was conducted to collect preliminary data necessary to select a sample for a more detailed follow-up survey, the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling (TSDR) Facilities. Respondents were required to complete the questionnaire under Section 3007 of the Resource Conservation and Recovery Act that authorizes collection of information for regulatory development purposes. Survey objectives included information that would: (1) uniquely identify the name, location, ownership, operating status, and commercial availability of every TSDR in the country; (2) characterize the type, scope, nature of the hazardous waste and the hazardous waste TSD and recycling operations onsite at each TSDR in the country; (3) be used in regulatory development; and (4) assist EPA in understanding the relationship between hazardous wastes managed in units exempt from RCRA regulation and hazardous wastes managed in units regulated under RCRA.

## 4210 Combustion Systems

*REFER ALSO TO CITATION(S) 7251, 7283, 7722, 8077, 8579, 8580, 8581, 8583, 8587, 8589, 8590, 8693, 8700, 8702, 8703, 8705, 8706*

8744 **(AD-A—197170/4/XAB) Application of remote-sensing optical instrumentation for diagnostics and safety of naval steam boilers. Annual technical report.** (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Jan 1988. 35p. NTIS, PC A03/MF A01.

Diagnostic sensors for monitoring the flame (flame quality), the presence of unburned hydrocarbon vapors, and the presence of liquid fuel on the floor of a burner are under development. Because safety and burner efficiencies are related to these conditions, sensors whose designs have been aimed at improving safety conditions can simultaneously be used to study efficiencies. Several techniques for evaluating the operating conditions of boiler flames are currently under investigation at the MHD Energy Center of MSU. These include a capacitance-based liquid monitoring system and two optical experiments for monitoring flame quality and hydrocarbon vapors, and all of these techniques are designed to be used in the flame region of a boiler. At present the optical experiments are bench top experiments which use natural gas flames and a small explosion test cell; however, these natural gas flames do not approximate the flame within an oil-fired boiler closely enough for complete development of these techniques.

8745 **(AGARD-AG—298-VOL-2) AGARD manual on aeroelasticity in axial-flow turbomachines. Volume 2. Structural dynamics and aeroelasticity.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Jun 1988. 266p. NTIS, PC A12/MF A01.

An overview of structural dynamics characteristics and analysis methods applicable to single blades and bladed assemblies is presented. The blade fatigue problem and its assessment methods, and life-time predictions are considered. Aeroelastic topics covered include: the problem of blade-disc shroud aeroelastic coupling, formulations and solutions for tuned and mistuned rotors, and instrumentation on test procedures to perform a fan flutter test. The effect of stagnation temperature and pressure on flutter is demonstrated and currently available forced vibration and flutter design methodology is reviewed.

8746 **(AGARD-AG—298-VOL-2) Forced vibration and flutter design methodology.** Snyder, L.E.; Burns, D.W. (Detroit Diesel Allison, Indianapolis, IN (USA)). Jun 1988. 28p. NTIS, PC A12/MF A01.

The aeroelastic principles and considerations of designing blades, disks, and vanes to avoid high cycle fatigue failure is covered. Two types of vibration that can cause high cycle fatigue, flutter, and forced vibration, will first be defined and the basic governing equations discussed. Next, under forced vibration design the areas of source definition, types of components, vibratory mode shape definitions, and basic steps in design for adequate high cycle fatigue life will be presented. For clarification a forced vibration design example will be shown using a high performance turbine blade/disk component. Finally, types of flutter, dominant flutter parameters, and flutter procedures and design parameters will be discussed. The overall emphasis is on application to initial design of

blades, disks, and vanes of aeroelastic criteria to prevent high cycle fatigue failures.

8747 (AGARD-CP—422, pp 13) **Simulation study of spraying, streaming and vaporization phenomena associated with fuel injection.** Hebrard, P.; Lavergne, G. Jun 1988. (In French). NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Combustion modeling requires a knowledge of the limit conditions and the physical models that can often be provided only through experience. Such an experimentally-based approach for studying injection-associated phenomena, involving simulation starting from experimental measurements, is presented. An evaluation of the performances of the different types of injectors used in the combustion chambers is carried out through particle size analysis: local distribution of size, the Sauter mean diameter, and measurements of drop concentration. Models describing the phenomena of evaporation, acceleration and impact of drops on a hot wall were tested experimentally. The modeling of premixed fuel injection with a prevaporization type injector is discussed as an example of a modeling approach using experimental results.

8748 (AGARD-CP—422, pp 13) **Turbulence effects on the droplet distribution behind airblast atomizers.** Wittig, S.; Klausmann, W.; Noll, B. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Turbulent fluctuations of the airflow in gas turbine combustion chambers have decisive influence on the mixing of fuel droplets and air both in premixing regions and primary zones. Detailed measurements in a recirculating, droplet charged airflow in a combustor model are conducted with an optical diffraction type particle sizer. These investigations yield information about the local fuel concentrations as well as the local concentration weighted diameter distributions under cold and hot airflow conditions. The spray is produced by a prefilming airblast nozzle, which is built into the combustor model. The calculation of the above mentioned quantities using a new computational model shows that in considering turbulence fluctuations significant improvement of the results is obtained and excellent agreement between predicted and measured values is achieved. Therefore, the results indicate that turbulence can be one of the major influencing parameters on droplet distribution.

8749 (AGARD-CP—422, pp 12) **Nozzle airflow influences on fuel patternation.** Rosfjord, T.J.; Eckerle, W.A. (Clarkson Univ., Potsdam, NY (USA)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The velocity and turbulence levels downstream of eight variations of a model gas turbine, aerating, fuel nozzle were measured. The nozzle configurations were assemblies which purposefully altered the airflow in a swirler or contouring swirl vane trailing edges. Data were acquired by a traversing, two component laser velocimeter in planes 0.060 in. or 2.50 in. downstream from the nozzle exit. Analyses of these data indicated that very symmetric flow fields can be produced. Such control was easier to achieve for the airflow than the fuel, supporting the position that nozzle patternation quality was more dependent on the fuel distribution in the nozzle. The presence of swirler wakes could always be discerned at the nozzle exit; the extreme variations imposed by coarse swirlers could dominate the flow. Such airflow influences were not apparent in the velocity profiles at downstream locations. However, their influence in convecting a higher fuel mass flux persisted from the nozzle exit and produced extreme variations in the spray pattern.

8750 (AGARD-CP—422, pp 13) **Spray performance of a vaporizing fuel injector.** Jasuja, A.K.; Low, H.C. (Rolls-Royce Ltd., Bristol (England)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The spray performance of a vaporizer fuel injector of a type that has accumulated extensive service experience in sub- and super-sonic commercial and military aircraft applications is examined. Spray performance data covers a wide range of operating conditions including the effects of fuel quality as well as the atomizing air temperature. The objective is to further not only the current level of understanding regarding the fundamental functional aspects of vaporizer technology but also the data base for future designs.

8751 (AGARD-CP—422, pp 10) **Flame stabilization in a reheat combustor.** Cadiou, A. Jun 1988. (In several languages). NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

In a reheat burner, combustion is stabilized with flameholders. The stabilization depends on the following parameters: Mach number, temperature, pressure and equivalence ratio of the flow, flameholder geometry. Many experimental measurements have allowed the calculation of a correlating parameter including the Mach number and the temperature. For the geometry, studies on linear stabilizers in two-dimensional flows have shown that the height of the stabilizer is a convenient parameter. An accurate experimental study of the recirculation zone downstream annular flameholders in a axisymmetric flow have pointed out the effect of another geometrical parameter, the diameter of the flameholder. The experimental results have improved the knowledge of the flame stabilization mechanism downstream annular flameholders.

8752 (AGARD-CP—422, pp 10) **High performance turbofan afterburner systems.** Sotheran, A. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The modern turbofan afterburner is characterized by its high boost and efficiency and by its compact geometry which is achieved by locating the flameholding baffles immediately downstream of the turbine exhaust plane of the engine core and bypass gas stream. At the confluence, the stream divider may be a simple cylinder or it may be of lobed configuration to encourage mixing between the two gas streams in the downstream jet pipe in order to improve the unboosted thrust of the engine. The geometry of the afterburner hardware must be adapted to suit the choice of mixed or unmixed configurations. In flight, selection of the afterburner must be fast and reliable under all flight conditions with times to full thrust of the order of only a second or two. Both the light up and the subsequent acceleration to full thrust are expected to be smooth with no excessive initial thrust jump. Synchronization and matching of the afterburner fuel with the variable final nozzle must be accurate at all times to maintain the engine turbomachinery on its required running lines. The afterburner must always be free of combustion driven pressure oscillations which can occur either in cross stream modes or in longitudinal modes, both of which can be mechanically damaging and, in some cases, cause fan surge and other intolerable effects in the engine. The afterburner must incorporate appropriate measures to avoid various potential thermal problems including fuel boiling and gumming in the supply manifolds and excessive heat transfer to the jet pipe and aircraft engine bay.

8753 (AGARD-CP—422, pp 10) **Comparison of the performance of a reverse flow annular combustion chamber under low and high pressure conditions.** Joos, F.; Simon, B. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Combustor development testing is usually carried out under different pressure conditions; low pressure burning test for the optimization of the fuel distribution inside the combustor and high pressure tests for demonstrating the desired performance. Comparison of the results under these two test conditions often reveal discrepancies, especially in wall temperatures and exit temperature patterns, which cannot be attributed simply to the greater flame radiation and heat release rate associated with the tests at high pressure. Another cause, in particular, lies in differences in the fuel distribution in the primary zone as a function of pressure conditions. This phenomenon is demonstrated by measurements and 3-D 2-phase flow field calculations.

8754 (AGARD-CP—422, pp 13) **Flow characteristics of a model annular combustor.** Bicen, A.F.; Tse, D.; Whitelaw, J.H. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Measurements are reported of the velocity and passive scalar characteristics of the isothermal flow in a model combustor which comprises a T-vaporizer and two rectangular sectors of an annular combustor similar to one used in small gas turbine engines. Mean temperatures were also obtained in a reacting flow with an overall equivalence ratio similar to that of takeoff conditions. The results were obtained with a combination of laser velocimetry, thermocouples and probe techniques and quantify the effects of flow asymmetries in the vaporizer fuel arrangement and of different alignments of the primary holes with respect to the vaporizer position. Flow visualization results are also included to indicate the general features of the combustor flow.

8755 (AGARD-CP—422, pp 16) **Fuel effects on flame radiation and hot-section durability.** Moses, C.A.; Karpovich, P.A. (Naval Air Propulsion Test Center, Trenton, NJ (USA)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The results of combustor experiments relating to fuel effects on combustor durability are summarized and analyzed with respect to Navy aircraft operations and maintenance. By combining life ratio models with data on mission profiles, models were developed that predict the impact of flying an aircraft on a fuel of reduced hydrogen content in terms of the combustor life lost in flying a typical mission. To determine the effect of decreasing hydrogen content on maintenance requirements, the life ratio models were combined with data obtained from maintenance depots on combustor life along with information on the importance of combustor life in determining engine overhaul schedules. From this, it was possible to identify which engines or aircraft would be most affected by decreases in hydrogen content, and at what point increases in maintenance requirements are likety to be realized.

8756 (AGARD-CP—422, pp 22) **Radiation transfer in gas turbine combustors.** Carvalho, M.G.; Coelho, P.J.M. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The prediction of the local flow, heat transfer and combustion processes inside a three-dimensional can combustor chamber of a gas turbine is presented. A 3-D numerical solution technique is used to solve the governing time averaged partial differential equations and the physical modeling for the turbulence, combustion and thermal radiation. The heat transfer modeling is emphasized. A method to calculate the distribution of temperature, radiative heat flux and total heat flux of the liner is described. The implications of neglecting radiative heat transfer in gas turbine combustion chamber calculations are discussed. The influence of working pressure on the radiative heat transfer is investigated comparing the radiative heat flux and the temperature distribution of the liner for three different working pressures: 5, 15 and 25 bar.

8757 (AGARD-CP—422, pp 10) **Gas turbine smoke measurement: a smoke generator for the assessment of current and future techniques.** Girling, S.P. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Smoke measurement from gas turbine engines is one instrumentation technique that remains, literally, a black art. Current methods are inaccurate, slow, insensitive and unable to detect transients. A smoke generator was developed capable of generating by pyrolysis of aviation kerosene, stable levels of smoke for prolonged periods, representative of that from engines. Particle size measurements have enabled the comparison of smokes from different sources and provided a greater understanding of the problems of representative sampling using currently approved methods. Several alternative measurement techniques were evaluated using the smoke generator, precluding the need for expensive engine testing. This has promoted research into instrumentation that will give a truer indication of particulate criteria of interest to the engine designer and customer, for example truer visibility and erosiveness.

8758 (AGARD-CP—422, pp 11) **Particle size measurements in sooting combustion systems.** Wittign, S.; Feld, H.J. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

Radiation effects caused by the presence of soot particles are of dominant influence in gas turbine combustors, especially on the stress distribution in the flame tube. In studying the two-phase flow within and after the combustor experimentally, a wide spectrum of soot particle and fuel droplet sizes is to be considered. Two optical measuring techniques were used throughout. First, the dispersion quotient (DQ) technique was applied to determing the size of the early soot particles, i.e., in the small-diameter range. The second method, the well established Multiple-Ratio-Single-Particle Counter (MRSPC), was used to measure the larger particle sizes, i.e., fuel droplets and soot. Furthermore, attention was focused on data acquisition- and analysis-techniques. Experimental results were obtained from measurements in a combustor with high concentration of soot particles and in the exhaust gas of a gas turbine.

8759 (AGARD-CP—422, pp 25) **Numerical models for analytical predictions of combustor aerothermal performance characteristics.** Burrus, D.L.; Shyy, W.; Braaten, M.E. (General Electric Co., Schenectady, NY (USA)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

An overview of the work performed at GE Aircraft Engines under an ongoing program to develop and improve the sophisticated analytical models for the design and analysis of aircraft turbine engine combustors is presented. This effort has focused on the full three-dimensional (3-D) elliptic combustor internal flow model. The objectives of the program are reviewed. The progress made in the past five years is discussed starting with the initial application and assessment of first generation 3-D combustor models based on cartesian grids, progressing to the development and recent application of an improved second generation 3-D combustor model based on a body fitted generalized curvilinear grid. Finally, a brief review of planned future modeling activities to be conducted under this program will be discussed.

8760 (AGARD-CP—422, pp 14) **Gas turbine combustion modeling.** Mongia, H.C. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

To effectively use multidimensional models for gas tubine combustor design and development activities, a method is presented to compute aerothermal performance parameters including CO, unburned hydrocarbon, NOx and smoke emissions; lean blowout and ignition fuel/air ratios, and pattern factor. To further improve modeling accuracy, advances are required in numerics and physical submodels of turbulence and spray transport processes. A status report is presented on the ongoing Allison modeling activities.

8761 (AGARD-CP—422, pp 14) **Three-dimensional gas turbine combustor modelling.** Wild, P.N.; Boysan, F.; Swithenbank, J.; Lu, X. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A mathematical model of the finite difference type is employed to predict the three-dimensional reacting flows within realistic combustor geometries. Both algebraic stress and k-epsilon submodels were employed for turbulence, together with combustion models of the Magnussen type and a detailed fuel spray model. A Lagrangian type model for the calculation of residence time distribution has also proved useful in validating the predicted flow fields. Modeling is carried out for a cylindrical combustor can and for a sector of an annular gas turbine burner. Both of these possess swirl stabilized primary zones. Experimental measurements of gas velocity, combustor resistence time distribution, composition and temper-

ature were employed for model validation and results obtained to date were encouraging.

8762 (AGARD-CP—422, pp 14) **Application of finite-difference techniques for the computation of the flow field in gas turbine combustors with complex geometries.** Wittig, S.; Bauer, H.J.; Noll, B. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A finite-volume method is presented for solving the time-averaged two-dimensional Navier-Stokes equations in non-orthogonal curvilinear coordinates. In contrast to most existing codes, a non-staggered grid is employed for the discretization of the momentum equations avoiding the onset of pressure and velocity ocsillations by additional steps. In a first step, turbulent transport is taken into account by the standard k, -model. As a test-case, the turbulent flow through a model combustor with variable cross-sectional area and dilution air jets is considered. The results of the computations are compared with measurements as well as with finite-difference calculations of other available codes utilizing orthogonal coordinates especially adapted for this geometry. The advantages of the new non-orthogonal approach are demonstrated. It is shown that the proposed mathematical model serves as a powerful tool for the computation of turbulent separated flows in ducts with complex geometries pertinent to modern gas turbine combustors, especailly those of the reverse-flow type.

8763 (AGARD-CP—422, pp 14) **Numerical modeling of combustion processes in gas turbines.** Galfetti, L.; Belli, M.; Bruno, C. (Consiglio Nazionale delle Ricerche, Peschiera Borromeo (Italy)). Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

The indications coming from fundamental turbulence research were incorporated in combustor modeling without a systematic analysis of their effect on predictions. Comparisons are presented between finite rate (overall) kinetics and equilibrium in their influence on the structure of the recirculation region attached to a disk flame-holder. The effect of including density gradient terms in the k-epsilon turbulence model is also examined. The results indicate that the fluid dynamic field may determine whether equilibrium or kinetics produces higher temperatures, and that the temperature difference predicted with the two approaches tends to become small with increasing pressure. The effect of introducing density gradients has a moderate effect on temperature.

8764 (AGARD-CP—422, pp 12) **Small annular combustor of high power density, wide operating range and low manufacturing cost.** Collin, K.H. Jun 1988. NTIS, PC A22/MF A01. (CONF-8710419—).

From Combustion and fuels in gas turbine engines; Chania, Greece (19 Oct 1987).

A short description will be given of the design and manufacturing philosophy, testing, and optimization of a combustion chamber. The features and design layout of the burner are characterized by the requirements for a low cost propulsion system for an unmanned flight vehicle, such as RPV and drones. Rig test results for the ignition and the performance over a wide operating range will be discussed. Ignition by hot gas from a cartridge as well as experience with testing this combustor in the demonstrator turbojet engine will be described.

8765 (CONF-8803160—) **First European conference on industrial furnaces and boilers: Proceedings.** Collin, R.; Leuckel, W.; Reis, A.; Ward, J. (eds.). (Coimbra Univ. (Portugal)). 1988. 310p. NTIS (US Sales Only), PC A14 - OSTI. Order Number TI89003314/JAW.

From 1. European conference on industrial furnaces and boilers; Lisbon, Portugal (21 Mar 1988).

The proceedings of the First European Conference on Industrial Furnaces and Boilers are contained in these pages. The papers presented at the conference range in scope from overviews of demonstration programs to mathematical models of heat transfer. (JF)

8766 (DOE/ID/12597—2) **Oxygen enriched combustion system performance study: Volume 3, Burner tests and combustion modeling: Final report, Phase 1.** Kwan, Y.; Abele, A.R.; Richter, W.; Chen, S.L.; Payne, R.; Kobayashi, H.; Silver, S.L. (Energy and Environmental Research Corp., Irvine, CA (USA); Union Carbide Corp., Tarrytown, NY (USA). Linde Div.). Sep 1988. Contract AC07-85ID12597. 181p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004060/JAW.

Oxygen enriched combustion (OEC) has been shown to have significant energy savings potential in industrial furnace applications. High temperature industrial furnaces, such as glass melting furnaces, appear to be the most promising applications for oxygen enriched combustion. In these applications, the principal energy savings result from minimizing the fuel energy required to heat the diluent nitrogen in air. The results of technical and economic assessment of OEC and market assessment were reported in Volume 1 and 2 of the current study. This report describes the results of burner evaluation tests over a range of oxygen enrichment and a numerical simulation study. The first part refers to the experimental results of both conventional air-fired burners and specially designed oxygen-fuel burners, evaluated at two scales. Part 2 of this report is concerned with the application of a computer code to extrapolate the results from small scale combustion tests to industrial furnaces. The experiments were designed as a comparative evaluation to: determine the operating range of different burner designs with oxygen enrichment; measure detailed flame characteristics for both air and enriched oxygen conditions; and estimate expected performance from research furnace results to actual industrial applications. 14 refs., 76 figs., 20 tabs.

8767 (EPRI-AP—6119) **Combustion turbine vibration monitoring: Practices, trends, techniques, selection, and benefits: Final report.** Lifson, A.; Smalley, A.J. (Electric Power Research Inst., Palo Alto, CA (USA); Southwest Research Inst., San Antonio, TX (USA). Applied Physics Div.). Dec 1988. 131p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004389/JAW.

This report assesses current vibration monitoring practices on combustion turbines. It shows, with 22 examples, how vibration monitoring has successfully trapped defects to avoid costly damage. The report analyzes these defects and shows how to enhance their detection by exploiting state-of-the-art vibration monitoring technology. The report describes the capabilities, selection factors, and costs of computerized on-line and periodic off-line vibration monitoring systems, and addresses the capture of vibration data during speed transients and steady state operation. It analyzes construction application and limitations of conventional vibration sensors as well as advanced sensors for detecting blade defects. The report presents practices and recommendations for vibration alarm and trip limits on combustion turbine and its auxiliary equipment. It presents the results of analyzing the ERAS data base, with detailed statistics and probability distributions on unavailability and repair rates of vibration-related outages. The report summarizes verbatim responses, statistical data, and results of the industry questionnaire survey. In addition, it presents, classified by topic, a bibliography of approximately 125 source material references. 20 refs., 47 figs., 9 tabs.

8768 (JPL-D—5699) (ECUT) **Energy Conversion and Utilization Technologies Program: Spray combustion modeling and evaluation: Annual summary report CY 1988.** Massier, P.F.; Bellan, J.; Kwack, E.; Shakkottai, P.; Harstad, K.; Gavalas, G.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Dec 1988. Contract AI01-86CE90237. 30p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003910/JAW.

In accord with the reporting schedule of the CY 1988 AOP this Report summarizes the significant technical progress during the period January 1, 1988 through December 30, 1988, for the Spray Combustion Modeling and Evaluation Task. The overall objective of this task is to produce and evaluate an analytical model of multicomponent-fuel spray combustion. It is intended that such a model could ultimately be incorporated into a composite computer program for predicting the performance of furnace and boiler designs fired with arbitrary liquid fuels. The primary intermediate objectives for CY 1988 are: to document a computer coded combustion

model of single-component nondilute fuel-spray combustion, to initiate a model for individual multicomponent-fuel drop evaporation, to conduct experiments of cenosphere combustion for model verification, and to continue to obtain cenosphere formation data experimentally for modeling input. 20 refs., 11 figs.

8769 **(N—89-10156) T55-L-712 turbine engine compressor housing refurbishment-plasma spray project.** Leissler, G.W.; Yuhas, J.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1988. 44p. (NASA-TM—101310; E—4301; NAS—1.15:101310). NTIS, PC A03/MF A01.

A study was conducted to assess the feasibility of reclaiming T55-L-712 turbine engine compressor housings with an 88 wt percent aluminum to 12 wt percent silicon alloy applied by a plasma spray process. Tensile strength testing was conducted on as-sprayed and thermally cycled test specimens which were plasma sprayed with 0.020 to 0.100 in. coating thicknesses. Satisfactory tensile strength values were observed in the as-sprayed tensile specimens. There was essentially no decrease in tensile strength after thermally cycling the tensile specimens. Furthermore, compressor housings were plasma sprayed and thermally cycled in a 150-hr engine test and a 200-hr actual flight test during which the turbine engine was operated at a variety of loads, speeds and torques. The plasma sprayed coating system showed no evidence of degradation or delamination from the compressor housings. As a result of these tests, a procedure was designed and developed for the application of an aluminum-silicon alloy in order to reclaim T55-L-712 turbine engine compressor housings.

8770 **(N—89-11192) Sensors for ceramic components in advanced propulsion systems: summary of literature survey and concept analysis, task 3 report.** Bennethum, W.H.; Sherwood, L.T. (General Electric Co., Cincinnati, OH (USA)). Aug 1988. 108p. (NASA-CR—180900; NAS—1.26:180900). NTIS, PC A06/MF A01.

The results of a literature survey and concept analysis related to sensing techniques for measuring of surface temperature, strain, and heat flux for (non-specific) ceramic materials exposed to elevated temperatures (to 2200 K) are summarized. Concepts capable of functioning in a gas turbine hot section environment are favored but others are reviewed also. Recommendation are made for sensor development in each of the three areas.

8771 **(NAL-TR—955) Study on twin valveless burner. Combustion stability and mixing patterns.** Eguchi, Kuniinisa; Gomi, Mitsuo; Kurosawa, Yoji; Fujii, Shoichi; Saito, Kazuo. (National Aerospace Lab., Chofu, Tokyo (Japan)). Dec 1987. 17p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755748/JAW.

Following results were clarified by the detailed measurement and visualized flow situation of the heat generation rate and the pressure variation in a combustion chamber of s twin valveless pulse burner. (1) variation of heat generation rate occurs at the same cycle as the pressure variation, and the heat continuously evolves at the minimum of the cycle. (2) Phase difference between the heat generation rate and the pressure depends on the ratio of equivalent, but is not influenced by the mass velocity. A most imporatant factor is a mixing rate of fuel and air. (3) Oscillation frequency increases with the increase of mass velocity but decreases with the increase of the equivalent ratio. This fact is not found in the case of a single cylinder type mechanical valve burner. (4) For the stabilized pulse combustion, it is necessary to increase the conversion rate of oscillation energy. (20 figs, 1 tab, 15 refs)

8772 **(NP—9770179) Development and testing of combustion systems - NOVOCAL. Final report.** Nickel, E.; Schaefer, C. (Buderus A.G., Ewersbach (Germany, F.R.). Werk Omnical). (Buderus A.G., Wetzlar (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1987. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770179/JAW.

The Buderus AG Wetzlar erected in its works Omnical Ewersbach an experimental plant for the examination of combustion systems for solid fuels. The steam boiler of this plant has been operated with an atmospheric fluidized bed firing system without and with a recirculation of ash as well as with a newly developed watercooled advance feed grate. By the firing of different solid fuels, the operating behaviour of the mentioned firing systems has been examined. As a result the recirculation of ash in the fluidized bed firing, a considerable improve of the firing and emission values could be obtained. It had been proved that the feed grate can be safely operated. The combustion results are excellent and the emission values according to 'TA-Luft' (Clean Air Technical Guide) could be achieved. In order to reduce the NO/sub 2/-values, the flue gas recirculation and a step by step dosage of the combustion air have been tested. (orig.) With 12 refs. 47 figs.

8773 **(PB—88-250527/XAB) Evaluation of low-emission coal-burner technology on industrial boilers.** (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1988. 778p. NTIS, PC E99/MF E99.

Set includes PB—88-250535 through PB—88-250550.

A separate abstract is included for each of the 3 volumes of this set.

8774 **(PB—88-250535/XAB) Evaluation of low-emission coal-burner technology on industrial boilers. Volume 1. Technical report. Final report, October 1978-September 1986.** Folsom, B.A.; Abele, A.R.; Reese, J.L.; Sommer, T.M. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1988. 492p. NTIS, PC A21/MF A01.

See also Volume 2, PB—88-250543; Also available in set of 3 reports PC E99, PB—88-250527.

This report gives results of a field evaluation of the Distributed Mixing Burner (DMB) on a 98-kg/hr (215,000 lb/hr) steaming-capacity, four-burner, front-wall-fired boiler. Following DMB installation, the boiler was operated and tested with the new burners for 17 months. Under routine operation, the DMBs reduced NOx emissions by about 50%-from the baseline condition of about 0.96 to about 0.46 lb/million Btu (418 to 200 ng/J). Under carefully controlled, optimized conditions, NOx emissions were further reduced about another 20%-to about 0.3 lb/million Btu (131 ng/J). The DMB is a low-NOx pulverized-coal burner for wall-fired boiler applications. It operates under reducing conditions in the primary flame zone to minimize NOx emissions while an overall oxidizing environment is maintained in the furnace to minimize slagging and corrosion.

8775 **(PB—88-250543/XAB) Evaluation of low-emission coal burner technology on industrial boilers. Volume 2. Appendices. Final report, October 1978-September 1986.** Folsom, B.A.; Abele, A.R.; Reese, J.L.; Sommer, T.M. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1988. 192p. NTIS, PC A09/MF A01.

See also Volume 1, PB—88-250535 and Volume 3, PB—88-250550; Also available in set of 3 reports PC E99, PB—88-250527.

This report gives results of a field evaluation of the Distributed Mixing Burner (DMB) on a 98-kg/hr (215,000 lb/hr) steaming-capacity, four-burner, front-wall-fired boiler. Following DMB installation, the boiler was operated and tested with the new burners for 17 months. Under routine operation, the DMBs reduced NOx emissions by about 50%-from the baseline condition of about 0.96 to about 0.46 lb/million Btu (418 to 200 ng/J). Under carefully controlled, optimized conditions, NOx emissions were further reduced about another 20%-to about 0.3 lb/million Btu (131 ng/J). The DMB is a low-NOx pulverized-coal burner for wall-fired boiler applications. It operates under reducing conditions in the primary flame zone to minimize NOx emissions while an overall oxidizing environment is maintained in the furnace to minimize slagging and corrosion.

8776 **(PB—88-250550/XAB) Evaluation of low-emission coal burner technology on industrial boilers. Volume 3. Guideline manual. Final report, October 1978-September 1986.** Folsom, B.A.; Abele, A.R.; Reese, J.L.; Sommer, T.M. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1988. 94p. NTIS, PC A05/MF A01.

See also Volume 2, PB—88-250543; Also available in set of 3 reports PC E99, PB—88-250527.

This report gives results of a field evaluation of the Distributed Mixing Burner (DMB) on a 98 kg/hr (215,000 lb/hr) steaming capacity, four-burner, front-wall-fired boiler. Following DMB installation, the boiler was operated and tested with the new burners for 17 months. Under routine operation, the DMBs reduced NOx emissions by about 50%-from the baseline condition of about 0.96 to about 0.46 lb/million Btu (418 to 200 ng/J). Under carefully controlled, optimized conditions, NOx emissions were further reduced about another 20%-to about 0.3 lb/million Btu (131 ng/J). The DMB is a low-NOx pulverized-coal burner for wall-fired boiler applications. It operates under reducing conditions in the primary flame zone to minimize NOx emissions while an overall oxidizing environment is maintained in the furnace to minimize slagging and corrosion.

8777 **(PB—88-250824/XAB) Low-NOx, high-efficiency multistaged burner: gaseous-fuel results.** Srivastava, R.K.; Mulholland, J.A. (Acurex Corp., Research Triangle Park, NC (USA)). Feb 1988. 10p. NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 7, No. 1, 63-70(Feb 1988).

This paper discusses the evaluation of a multistaged combustion burner design on a 0.6-MW package boiler simulator for in-furnace NOx control and high combustion efficiency. Both deep air staging, resulting in a three-stage configuration, and boiler front wall fuel staging of undoped natural gas, yielding four stoichiometric zones, reduced the baseline NO emission by about 50% to 160 ppm, meeting the program goal. However, deep air staging resulted in the entire front end of the boiler being fuel-rich and required penetrations into the boiler for staged air injection. The fuel staging results, on the other hand, required no boiler penetrations and only a small fuel-rich flame core in the boiler. Further, sufficient air for complete oxidation of the primary combustion products was provided at the burner exit, prior to staged fuel and air injection in the boiler, in the fuel staging tests.

8778 **(PB—89-104152/XAB) Solid-fuel Combustion Chamber Progress Report 12, July-December 1987.** Wittenberg, H.; Korting, P.A.O.G.; Zanbergen, B.T.C.; Wijchers, T.; Elands, P.J.M. (Technische Hogeschool Delft (Netherlands). Dept. of Aerospace Engineering). Apr 1988. 48p. (LR—555). NTIS, PC A03/MF A01.

See also PB—89-104145. Also pub. as Prins Maurits Lab. TNO, Rijswijk (Netherlands) Report PML 1988-C32.

An overview of the July-December 1987 period of the Solid-Fuel Combustion Chamber (SFCC) project (1) is given. In chapters 2-5 an update is presented on project support and project personnel. Chapters 6 and 7 present an overview of the research activities carried out in the period. The research activities included, among others, the modeling of the fuel mass flow as a function of the (convective) heat flux, initial experiments with HTPB fuels and the evaluation of the Laser Doppler Anemometry (LDA) technique for local flow velocity measurements (Laser Doppler Velocimetry, LDV). Many valuable contacts are reported in chapters 8 - 10. Of these, it is especially mentioned that PMLTNO has joined a study group to evaluate the applicability of ramjet propulsion. Finally, the report also includes a general assessment of the program status (chapter 10), an outline of the next half-year period (chapter 11) and an update of the Phase 2 timetable (chapter 12).

8779 **Optical flow computation in combustion image sequences.** Strickland, R.N.; Sweeney, D.W. (University of Arizona, Department of Electrical & Computer Engineering, Tucson, Arizona 85721). *Applied Optics;* **27**: No. 24, 5213-5220(15 Dec 1988).

A time-resolved sequence of laser shadowgraph images is computer processed to produce 2-D optical flow maps showing the motion of the combustion interface between hot products and cold reactants. Background-subtracted shadowgraph images are reduced to skeletons, followed by local correlation between adjacent frames for computing optical flow. The resulting flow maps represent an initial step toward the goal of computer-assisted flowfield analysis and interpretation.

## 4220 Underground Engineering

*REFER ALSO TO CITATION(S) 7434*

8780 **(SAND—88-1481C) The thermal response of rock to friction in the drag cutting process.** Glowka, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 50p. (CONF-8808167—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002881/JAW.

From International conference on friction phenomena in rock; Fredericton, Canada (24 Aug 1988).

Significant friction between the cutter and the rock occurs during the drag cutting process. This friction is responsible for elevating the temperature of the drag cutter and, under certain conditions, reducing cutter life. Because of this effect, friction often plays a major role in determining the economics of drilling with drill bits employing polycrystalline diamond compact (PDC) cutters. Analytical models have been developed in previous studies for predicting PDC cutter temperatures and their effects on bit wear and performance. The current paper investigates the effects of drag cutter friction on the rock. The thermal and mechanical loading imposed during the cutting process is described, with emphasis on the rock response. Of particular interest is the thermal response of the rock to the frictional heating and convective cooling conditions imposed during drilling. The friction and thermal models developed for PDC cutters are extended and applied to quantitatively determine these conditions for the typical downhole environment. An analytical solution is then applied to determine the thermal response of the rock mass. The results show that contact pressures and temperatures experienced by rock chips during the drag cutting process are in the range where a limited degree of metamorphism of some rock constituents is possible. It is concluded that because of the brief exposure time and shallow penetration of frictional heat, any metamorphic changes that do occur do not extend more than a fraction of a millimeter beyond the rock surface. 26 refs., 25 figs., 2 tabs.

## 4230 Marine Engineering

*REFER ALSO TO CITATION(S) 8618*

8781 **(AC—FR1727C) Parametric model study of MV Arctic hydroelastic response during multi-year ice impacts. 2 Vols.** (Arctec Canada Ltd., Kanata, Ontario). Jun 1985. 333p. (CE—01975). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes physical modeling of a Canadian ship designed for Arctic service and documents development of a model test technology which represents the ships dynamic characteristics. A flexible ship model composed of 12 segments was employed. Infinite multi-year ice was simulated with synthetic model ice blocks. Bow force components, bending stress and accelerations were measured, and variation in parameters carried out. Analysis of results show good agreement with available full scale trials data. Extrapolation of trends to the ships design speed is shown and prediction equations for peak vertical bow force and maximum deck stress are derived. A fourier transform methodology for prediction of vertical bow force on the basis of deck strain is experimentally proven, which allows extension to finite floe problems. A physical mechanism is formulated which explains ship response in terms of modal characteristics and forefoot geometry. The report concludes that the physical modeling assumptions and their applicability for extrapolating to higher speeds have been verified. 5 refs., 173 figs., 14 tabs.

## 4240 Pollution Control Equipment

*REFER ALSO TO CITATION(S) 7717, 9213, 9224*

8782 **(PB—88-251723/XAB) Fabric filtration with integral particle charging and collection in a combined electric and flow field. Part 1. Background, experimental work, analysis of data, and approach to the development of a mathematical engineering design model.** Plaks, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1988. 22p. (EPA—600/J-88/082). NTIS, PC A03/MF A01.

Pub. in Jnl. of Electrostatics, Vol. 20, 247-266(1988). See also PB—88-251731.

This paper discusses a system of integral particle charging and collection in a combined electric and flow field that was developed to provide pressure-drop reductions that are larger than previously reported in electrified fabric filtration. A mathematical model was developed that predicts the nonuniform deposition that results and the relative pressure drop as compared to conventional nonelectrified filtration. The paper gives the background in applying electrostatics to fabric filtration. It discusses the technique for integral particle charging and collection in a combined electrical field. It describes an experimental program that would provide the data needed to prepare a mathematical engineering design model. Measurements of areal density, drag, thickness, and dust-cake bulk density were made upon particle layers deposited on fabric filters with integral particle charging and collection with a combined electric and flow field.

8783 **(PB—88-251731/XAB) Fabric filtration with integral particle charging and collection in a combined electric and flow field. Part 2. Development and verification of the mathematical engineering design model.** Plaks, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1988. 26p. (EPA—600/J-88/083). NTIS, PC A03/MF A01.

Pub. in Jnl. of Electrostatics, Vol. 20, 267-290(1988). See also PB—88-251723.

This paper discusses the development of a mathematical engineering design model to predict the nonuniform deposition of particulate matter and the relative pressure drop, compared to conventional filtration, of fabric filtration with integral particle charging and collection. For the model, the bag length is divided into a number of increments for each of which collections for the ESP and porous flow are computed separately. Turbulent flow within the bag requires the use of the Deutsch-Anderson relationship for the ESP collection. The relative pressure drop is calculated by first relating the computed areal density in each increment to the drag, which is resistance to flow. The predictions for small test bags, whose operation was outside the range of assumptions used for model development, were qualitatively correct. For large fabric-filtration bags of the size used in practical industrial applications, whose operation is within the range of assumptions, the model provides reasonably-well-quantified predictions.

8784 **(PB—89-106272/XAB) Electrostatic precipitator with new energization system.** Fujishima, H.; Tomimatsu, K.; Matsumoto, Y.; Yagyu, T.; Nakayama, Y. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01.

Included in Mitsubishi Technical Review, Vol. 25, No. 2, 115-120(Jun 1988).

The collecting efficiency of a conventional electrostatic precipitator (EP) decreases when dust resistivity becomes high due to the back corona phenomenon. Mitsubishi Heavy Industries, Ltd. (MHI) has developed a new type of EP that suppresses back corona thus providing better efficiency even when dust resistivity is high. The principle of the new EP is basically to provide a high pulse peak voltage onto the discharge electrodes of the precharging section to maximize dust charge. The pulse voltage is supplied from a directly coupled pulse generator developed by MHI. MHI has already installed four EPs incorporating the pulse precharger, which have demonstrated enhanced collecting efficiency for high-resistivity dust. A large capacity directly-coupled pulse generator was also connected to a whole field of conventional EPs, and better collecting efficiency was attained for high-resistivity dust.

8785 **(PB—89-851760/XAB) Aircraft gas-turbine engines: noise reduction and vibration control. January 1973-November 1988 (Citations from Information Services in Mechanical Engineering data base). Report for January 1973-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 92p. NTIS PC N01/MF N01.

Supersedes PB—86-871456.

This bibliography contains citations concerning the design of aircraft gas-turbine engines with respect to noise reduction and vibration control. The aerodynamics of inlet design is presented for several types of engine applications including turbofan, turboprop, and vertical takeoff and landing aircraft. Helicopter engines are excluded from this bibliography. (This updated bibliography contains 212 citations, 28 of which are new entries to the previous edition.)

## 4250 Power Cycles

8786 **(NP—9770170) Thermodynamic and tribological simulation models for different types of positive displacement compressors.** Lindemann, H. (Deutscher Kaelte- und Klimatechnischer Verein e.V., Stuttgart (Germany, F.R.)). 1985. 219p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE89770170/JAW.

A program system for process analysis of positive displacement compressors on the basis of general physical theories is presented. The compressor process is described on the basis of real gas equations describing changes of phase of the refrigerants. The slide bearings and sealing elements are calculated on the basis of the fundamental equations of the hydrodynamic lubricating film theory, leading to the non-stationary, two-dimensional Reynolds differential equation. Different program structures were developed for lifting-piston, rare-cell, rolling-piston, and rotary-piston compressors in order to describe and analyze the thermodynamic and mechanical losses. The processes in open compressors were analyzed with particular interest in order to exclude interactions between the engine and the compression process. (HWJ).

# 43 PARTICLE ACCELERATORS

*REFER ALSO TO CITATION(S) 10111*

8787 **(CNIC—00169) High-current narrow-pulse electron beam source.** Guan Gexin; Li Youzhi; Pan Yuli. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Apr 1988. 6p. (In Chinese). (IAE—0042). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705067/JAW.

The ferrite-transmission-line ns-power pulse generator is used to drive the Pierce grid gun in the electron beam source. When the cathode voltage is -82 kV, the source has a peak output current of 19 A with the pulse width of 2.4 ns. According to the result of the measurement, the effects on beam pulse and gun design of the electron transit time between electrodes are discussed.

8788 **(GSI—88-17) High energy density in matter produced by heavy ion beams. Annual report 1987.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1988. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755945/JAW.

Research activities presented in this annual report were carried out in 1987 in the framework of the government-funded program 'High Energy Density in Matter Produced by Heavy Ion Beams'. It addresses fundamental problems of the generation and investigation of hot dense matter. Its initial motivation and its ultimate goal is the question whether inertial confinement can be achieved by intense heavy ion beams. The new accelerator facility SIS/ESR now under construction at GSI will provide an excellent potential for research in this field. The construction work at the new validity is on schedule. The building construction is near completion and the SIS accelerator will have its first beam at the beginning of next year. First experiments at lower intensity will start in summer 1989 and the full program will run after the cooler and

storage ring ESR has got operational. Accordingly, the planning and the preparation of the high energy density experiments at this unique facility was an essential part of the activities last year. In this funding period emphasis was given to the experimental activities at the existing accelerator. In addition to a number of accelerator-oriented and instrumental developments, an experiment on beam-plasma interaction had first exciting results, a significant increase of the stopping power for heavy ions in plasma was measured. Other important activities were the investigation of dielectronic recombination of highly charged ions, spectroscopic investigations aiming at the pumping of short wavelength lasers by heavy ion beams and a crossed beam experiment for the determination of Bi/sup +/ + Bi/sup +/ ionization cross sections. As in previous years theoretical work an space-charge dominated beam dynamics as well as on hydrodynamics of dense plasmas, radiation transport and beam plasma interaction was continued, thus providing a basis for the future experiments.

8789 **(JINR-D—9-87-105-Vol.1) Proceedings of the 10. All-union conference on accelerators of charged particles. Vol. 1.** Vesil'ev, A.A. (ed.). (AN SSSR, Moscow; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 458p. (In Russian). (CONF-8610271—). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW.

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Individual papers are indexed separately.

## 4301 Design, Development, And Operation

*REFER ALSO TO CITATION(S) 10110, 10131*

8790 **(AD-A—197700/8/XAB) Investigation of acceleration and densification of electrons utilizing travelling magnetic waves. Final report, 30 September 1983-31 October 1987.** Chen, K.W.; Kim, S.H. (Texas A and M Univ., College Station (USA). Texas Engineering Experiment Station). 19 Apr 1988. 20p. NTIS, PC A03/MF A01.

An experimental investigation of electron-beam physics is reported. Naturally occurring and externally driven low-frequency (6-500 KHz) diocotron oscillations are observed and the m = 1 rotating structure of these oscillations are measured by using electrostatic probes. Systematic analysis of the circuit system for the generation of a fast-rising pinching magnetic field: a circuit consisted of distributed circuit (transmission line) part and lumped circuit parts included a coil are systematically analyzed from the first principles of circuit. A computer code to calculate expediently the temporal profile of the pinching magnetic field is developed. Theoretical study of acceleration of high-energy electron beams by a laser light through net inverse bremsstrahlung in plasma fields: the absorption of the incident laser photons by net inverse bremsstrahlung can give rise to the dc ponderomotive force whose strength is far greater than the amplitude of the Lorentz force of the laser wave. Study of a soft-x-ray free-electron laser (FEL) scheme using a two-beam elliptical pill-box wake-field cavity: it is found that the scheme provides sufficient gain as a coherent radiation source down to the x-ray regime. Wake field acceleration research: the theoretical result from the modal analysis developed here agrees with the recent experiment in both profile (shape) and magnitude of the wake potential. Development of a laser photocathode for the generation of high-current short-length electron bunch, and design and construction of a modified betatron: a modified betatron called the UTA Modified Betatron was constructed.

8791 **(BNL—41604) Workshop on the RHIC performance.** Khiari, F.; Milutinovic, J.; Ratti, A.; Rhoades-Brown, M.J. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1988. Contract AC02-76CH00016. 507p. (CONF-880335—). NTIS, PC A20 - OSTI. Order Number DE89004050/JAW.

From Workshop on the relativistic heavy ion collider performance; Upton, NY, USA (21 Mar 1988).

The most recent conceptual design manual for the Relativistic Heavy Ion Collider (RHIC) at Brookhaven was published in May 1986 (BNL 51932). The purpose of this workshop was to review the design specifications in this RHIC reference manual, and to discuss in detail possible improvements in machine performance by addressing four main areas. These areas are beam-beam interactions, stochastic cooling, rf and bunch instabilities. The contents of this proceedings are as follows. Following an overview of the workshop, in which the motivation and goals are discussed in detail, transcripts of the first day talks are given. Many of these transcripts are copies of the original transparencies presented at the meeting. The following four sections contain contributed papers, that resulted from discussions at the workshop within each of the four working groups. In addition, there is a group summary for each of the four working groups at the beginning of each section. Finally, a list of participants is given.

8792 **(BNL—42020) The Brookhaven Accelerator Test Facility.** Batchelor, K.; Chou, T.S.; Fernow, R.C.; Fischer, J.; Gallardo, J.; Kirk, H.G.; Koul, R.; Palmer, R.B.; Pellegrini, C.; Sheehan, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-881049—50). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004533/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The Brookhaven Accelerator Test Facility (ATF) will consist of a 50--100 MeV/c electron linac and a 100 GW $CO_2$ laser system. A high brightness RF-gun operating at 2856 MHz is to be used as the injector into the linac. The RF-gun contains a Nd:Yag-laser-driven photocathode capable of producing a stream of six ps electron pulses separated by 12.5 ns. The maximum charge in a micropulse will be one nano-Coulomb. The $CO_2$ laser pulse length will be a few picoseconds and will be synchronized with the electron pulse. The first experimental beam is expected in Fall 89. The design electron beam parameters are given and possible initial experiments are discussed. 9 refs., 1 fig., 3 tabs.

8793 **(BNL—42068) The RHIC [Relativistic Heavy Ion Collider] Project: Overview and status.** Hahn, H. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 22p. (CONF-880762—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004521/JAW.

From Summer institute: school and workshop on heavy ion physics; Upton, NY, USA (11 Jul 1988).

The Relativistic Heavy Ion Collider at Brookhaven will extend the present heavy ion capabilities of the AGS into an energy domain not available at any other laboratory within the foreseeable future. Operation of the AGS for heavy ion experiments started in October 1986 with the delivery of $O^{8+}$ beams. Subsequently, the mass range was extended with the AGS delivering typically 2{times}$10^8$ $Si^{14+}$ ions/pulse at a kinetic energy of 13.8 GeV/u. Completion of the AGS booster synchrotron in 1991 will extend the mass range to the heaviest ions, typically $^{179}Au$, with $^{238}U$ a definite possibility. The acceleration of heavy ions to very high energies at Brookhaven was already considered for the ISABELLE/CBA project. After its cancellation, the realization of a dedicated heavy ion collider in the vacant tunnel became feasible and the design objectives were defined in 1983 by a Task Force on Relativistic Heavy Ion Physics. The study of such a heavy ion accelerator/collider was initially supported by generic R&D funds and later on as part of the Brookhaven Exploratory Research Program. The results of this multi-year R&D effort were presented in the May 1986 Conceptual Design Report (CDR). This document remains valid in most respects but progress resulting from two years of intensive R&D work, now supported with direct DOE funds, in the areas of accelerator physics and superconducting magnet technology resulted in a few design improvements. The present paper summarizes the major features of the RHIC design with emphasis on those aspects of particular interest to the future user and it concludes with a short discussion of the superconducting magnet R&D program. 10 refs., 15 figs., 3 tabs.

8794 **(CONF-881049—43) The Atlas upgrade project.** Bollinger, L.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003890/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

ATLAS is a heavy-ion accelerator system consisting of a 9-MV tandem electrostatic injector coupled to a superconducting linac. A project now well advanced will upgrade the capabilities of ATLAS immensely by replacing the tandem and its negative-ion source with a positive-ion injector that consists of an electron-cyclotron resonance (ECR) ion source and a 12-MV superconducting injector linac of novel design. This project will increase the beam intensity 100 fold and will extend the projectile-mass range up to uranium. Phase 1 of the work, which is nearing completion in late 1988, will provide an injector comprising the ECR source and its 350-kV voltage platform, beam analysis and bunching systems, beam lines, and a prototype 3-MV linac. The ECR source and its voltage platform are operational, development of the new class of low-frequency interdigital superconducting resonators required for the injector linac has been completed, and assembly of the whole system is in progress. Test runs and then routine use of the Phase 1 injector systems are planned for early 1989, and the final 12-MV injector linac will be commissioned in 1990. 12 refs., 6 figs.

8795 **(CONF-881151—40) Heavy-ion acceleration with a superconducting linac.** Bollinger, L.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003970/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

This year, 1988, is the tenth anniversary of the first use of RF superconductivity to accelerate heavy ions. In June 1978, the first two superconducting resonators of the Argonne Tandem-Linac Accelerator System (ATLAS) were used to boost the energy of a $^{19}F$ beam from the tandem, and by September 1978 a 5-resonator linac provided an $^{16}O$ beam for a nuclear-physics experiment. Since then, the superconducting linac has grown steadily in size and capability until now there are 42 accelerating structures and 4 bunchers. Throughout this period, the system was used routinely for physics research, and by now the total time with beam on target is 35,000 hours. Lessons learned from this long running experience and some key technical developments that made it possible are reviewed in this paper. 19 refs., 3 figs., 2 tabs.

8796 **(CRN-VIV—42) Mechanical aspects of VIVITRON: the structure.** Gaudiot, G.; Koenig, R.; Cherrier, G.; Esteve, T.; Peter, R. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1987. 7p. (In French). (CONF-8707175—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756118/JAW.

From Biannual meeting of the French Physical Society; Strasbourg, France (6 Jul 1987).

The main aspects of the VIVITRON mechanical structure are discussed through a description of the tank and the internal structure. The results of the calculated constraints on the structure are presented.

8797 **(CTA-IEAV-NT—006/87) Determination of dimensions and theoretical evaluation of the performance of electron accelerator structures.** Fuhrmann, C.; Setrao, V.A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados). Mar 1987. 23p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704680/JAW.

A method to calculate the dimensions of a constant gradient disk-loaded structure of a linear accelerator is presented. The method is based on a description of the RF power flux along the structure axis and involves a particular dispersion that includes details of the iris geometry. The dimensions of the v/sub p/ = c structure and of the buncher section of the CURUMIM linear accelerator, have been determined as an application of the above method. The theoretical performance of the accelerating structure has been evaluated for electron pulse widths ranging from 10 ns to 2 μs and for peak currents up to 10 A.

8798 **(DOE/EIS—0138-Vol.1) Superconducting Super Collider: Final environmental impact statement: Volume 1.** (USDOE, Washington, DC). Dec 1988. 642p. NTIS, PC A99/MF A01 - OSTI. Order Number DE89004218/JAW.

This Environmental Impact Statement (EIS) provides as much information as possible at this stage of the project development regarding the potential environmental impacts of the proposed construction and operation of a Superconducting Super Collider (SSC) at each of the site alternatives. However, the DOE recognizes that further review under the National Environmental Policy Act (NEPA) is required prior to construction and operation of the proposed SSC project at the selected site based on more detailed design and to identify specific mitigation measures which can be incorporated into final design. Accordingly, following selection of a site for the proposed SSC, the DOE will prepare a Supplemental EIS to address in more detail the impacts of constructing and operating the proposed SSC at the selected site and alternatives for mitigating those impacts. To measure the effects of constructing the SSC at any of the seven alternative sites, the DOE determined which aspects of the human environment would be significantly affected. The EIS describes the baseline conditions at each of the seven site alternatives, the trends underway resulting in changes, the potential environmental impacts expected if the SSC were sited, possible mitigations of adverse impacts, and resulting residual adverse impacts.

8799 **(DOE/EIS—0138-Vol.4-App.5) Superconducting Super Collider: Final environmental impact statement: Appendix 5, Errata.** (USDOE, Washington, DC). Dec 1988. 173p. NTIS, PC A08 - OSTI. Order Number TI89004237/JAW.

This book contains Errata for Volume 4, Appendix 5. Paragraphs are counted from the top of the page, e.g., Par. 1 begins with the first line on the page, whether that line is the actual beginning of a paragraph or not. Minor changes in tables and figures are described in the Errata sheets. Tables and figures that are new or corrected and republished are presented at the end of each appendix section.

8800 **(DOE/EIS—0138-Vol.4-App.7) Superconducting Super Collider: Final environmental impact statement: Volume 4, Appendix 7.** (USDOE, Washington, DC). Dec 1988. 179p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004238/JAW.

This appendix has two primary sections: surface water and groundwater resource assessments. Each provides a discussion of the purpose, scope, and the methodology for impact assessment, followed by site-specific resource assessments. Notable changes or additions to this appendix from the DEIS are as follows: Additional assessment and figures for potential floodplain encroachment by SSC facilities at the Colorado, Illinois, Michigan, North Carolina, Tennessee, and Texas sites. Minor changes in direct and indirect water use estimates for the SSC at all seven sites. The most notable change is a small decrease in estimated operational industrial water use at both the campus and far cluster areas, while the estimated industrial water use at each of the remote service areas increased from 40 to 80 acre-ft/yr. Total estimated direct SSC water use did not change. Clarifications and/or adjustments as regards the number of wells lost due to siting and construction of the SSC at each of the seven sites. The figures showing wells within the SSC footprint at each site (inappropriately labeled "wells potentially affected" in the DEIS) are not included as available well location data do not seem appropriate for map presentation. Expanded discussion of the nature of the karst terrain at the Tennessee site. The potential for water level and groundwater quality impacts has been reassessed based on the existence of a more extensive shallow karst system than was assumed in the DEIS. Additional water availability and water use data for all seven sites. 61 refs., 15 figs., 8 tabs.

8801 **(DOE/EIS—0138-Vol.4-App.11) Superconducting super collider: Final environmental impact statement, Volume 4: Appendix 11.** (USDOE, Washington, DC). Dec 1988. 147p. NTIS, PC A07 - OSTI. Order Number DE89004240/JAW.

This ecological resources assessment focuses on identifying impacts of (construction and operations of the SSC) on the unique, unusual, or sensitive ecological systems at each of the proposed sites. Potential mitigations, where appropriate at the site selection phase of the SSC project, are also addressed. More detailed planning of mitigations will be required after selection of a site and

preparation of a site specific engineering design. Evaluation of detailed information will be included in the Supplemental EIS prepared for the selected site. This assessment addresses ecological impacts in the following areas: Sensitive terrestrial and aquatic communities; threatened, endangered, and state-protected species; Wetlands; and Commercially, recreationally, and culturally important species. This appendix contains impact assessment only. 30 refs.

8802 **(DOE/ER—0398) Nuclear physics accelerator facilities.** (USDOE Office of Energy Research, Washington, DC. Office of High Energy and Nuclear Physics). Dec 1988. 63p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89005290/JAW.

This paper describes many of the nuclear physics heavy-ion accelerator facilities in the US and the research programs being conducted. The accelerators described are: Argonne National Laboratory--ATLAS; Brookhaven National Laboratory--Tandem/AGS Heavy Ion Facility; Brookhaven National Laboratory--Relativistic Heavy Ion Collider (RHIC) (Proposed); Continuous Electron Beam Accelerator Facility; Lawrence Berkeley Laboratory--Bevalac; Lawrence Berkeley Laboratory--88-Inch Cyclotron; Los Alamos National Laboratory--Clinton P. Anderson Meson Physics Facility (LAMPF); Massachusetts Institute of Technology--Bates Linear Accelerator Center; Oak Ridge National Laboratory--Holifield Heavy Ion Research Facility; Oak Ridge National Laboratory--Oak Ridge Electron Linear Accelerator; Stanford Linear Accelerator Center--Nuclear Physics Injector; Texas A&M University--Texas A&M Cyclotron; Triangle Universities Nuclear Laboratory (TUNL); University of Washington--Tandem/Superconducting Booster; and Yale University--Tandem Van de Graaff.

8803 **(DOE/FTR—9004734) [Commissioning of the newly constructed Beijing electron-positron collider BEPC, Beijing, China, and visit to SRRC to discuss magnet manufacturing and measurement methods, Taipei, Taiwan, November 11--27, 1988]: Foreign trip report.** Weng, W.T. (Brookhaven National Lab., Upton, NY (USA)). 13 Dec 1988. Contract AC02-76CH00016. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004734/JAW.

The traveller was invited to IHEP to participate in the commissioning of the newly constructed Beijing electron-positron collider BEPC, give a status report on the AGS Booster Project and to assess the feasibility of sub-contracting booster sextupoles to IHEP. The trip to SRRC was undertaken to discuss magnet manufacturing and measurement methods.

8804 **(FNAL/C—88/145) An 805 MHz disk and washer structure for the Fermilab Linac Upgrade.** Moretti, A.; Young, D.; Lee, G.; Mills, F.E.; Zhou, P.; Swenson, D.A.; Young, P.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 3 Oct 1988. Contract AC02-76CH03000. 4p. (CONF-881049—44). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003125/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The Linac Upgrade program, a portion of the Tevatron Upgrade, calls for increasing the energy of the existing 200 MeV, 201.25 MHz linac to 400 MeV in order to reduce beam emittance degradation in the Booster. This is to be accomplished by replacing the last four Alvarez linac tanks with more efficient, higher gradient 805 MHz linac structure. One of the linac structures currently under study in a collaboration between Fermilab and SAIC is the Disk-and-Washer accelerating structure with bi-periodic tee supports, four per washer pair. This structure has a stop-band for the $TM_{11}$ mode (a problem in other designs) centered near the $\pi$ $TM_{02}$ accelerating mode frequency. A novel heat shrinking technique is used in the construction of a ten-cell one-meter long vacuum prototype structure. Description of the structure, testing techniques and test results are presented. 9 refs., 4 figs., 1 tab.

8805 **(IPPJ-DT—137) Abstracts of papers presented at research meeting 'new methods of particle acceleration based upon use of plasmas'.** Nishida, Yasushi (ed.) (Utsunomiya Univ. (Japan). Faculty of Engineering). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1988. 27p. (In Japanese). (CONF-8712130—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756057/JAW.

From Research meeting on new methods of particle acceleration based upon use of plasmas; Nagoya, Japan (22 Dec 1987).

This is a collection of extended abstracts of papers presented at a research meeting "New Methods of Particle Acceleration Based upon Use of Plasmas" held at the Institute of Plasma Physics of Nagoya University, on December 22 - 23, 1987, under the Collaborating Research Program at the Institute. Research activities of Potential Acceleration, Cross Field Acceleration (V/sub p/ x B Acceleration), and Synchronized Acceleration, were reported at the meeting and were summarized here briefly.

8806 (JINR-D—9-87-105-Vol.1, pp 109-114) **Development of the JINR U-400 - U-400M heavy ion accelerating complex.** Flerov, G.N.; Oganesyan, Yu.Ts.; Andriyanov, A.M. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The present-day status of the development of the JINR U-400-U-400M heavy ion accelerating complex designed for ion production from He to U at 120-20 MeV/nucleon energy and intensity up to 10/sup 12/ particle/s is given. The U-400 isochronous cyclotron is an injector in the accelerating complex. Up to now a series of research and development works concerning the main complex units is completed. The U-400M vacuum chamber, poles, sectors are being constructed. The construction completion is planned by 1989. 10 refs.; 10 figs.

8807 (JINR-D—9-87-105-Vol.1, pp 115-122) **Status report on AGOR.** Bieth, C. 1987. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The status of the AGOR is given. The machine is a compact, three-sector, three-dee superconducting cyclotron for accelerating protons up to 200 MeV. 9 refs.; 9 figs.

8808 (JINR-D—9-87-105-Vol.1, pp 131-135) **Construction of the ITs-100 heavy ion implantator.** Flerov, G.N.; Andriyanov, A.M.; Bogomolov, S.L. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The ITs-100 heavy ion implantator designed in JINR, which enables to accelerate ions in the range from /sup 11/B to/sup 40/Ar with A/Z=5.3-6.0 up to 1-1.25 MeV/nucleon energy is described. The main cyclotron characteristics and principal resonance system parameters are given. At present in the ITs-100 output beam channel a set-up is mounted and adjusted, which has enabled to irradiate polymer materials for nuclear filters by /sup 40/Ar/sup +7/ and /sup 22/Ne/sup +4/ ion beams. A high efficiency of the ITs-100 accelerator for large-scale production of nuclear filters is shown. The first experimental batches of nuclear filters in a wide range of pore diameters and thicknesses of the polymer film used for this purpose are produced. Radiation strengthening of different metals is tested experimentally using /sup 40/Ar/sup +7/ and /sup 22/Ne/sup +4/ ion beams. 7 refs.; 5 figs.; 2 tabs.

8809 (JINR-D—9-87-105-Vol.1, pp 136-139) **New regimes and modification of the Kiev 240-cm isochronous cyclotron.** Dem'yanov, A.V.; Linev, A.F.; Oklejnik, E.E.; Ol'khovskij, K.I.; Prokopenko, V.S.; Sakhno, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

To extend possibilities of the use of the Kiev 240-cm cyclotron (making and mastering of the acceleration modes of new particles, decrease of energy spread, increase of beam intensity, decrease of effective beam duty factor) the main assemblies are up-dated and reconstructed. Realization of the above works will enable to attain the following parameters: to increase output beam intensity two

times in average, bring beam energy spread up to 10/sup -3/ and significantly improve its time structure, produce polarized proton, deuteron and lithium beams, reduce electric power per 1 h of cyclotron efficiency by 20%, bring useful cyclotron operation time up to 6000 hs per a year. 4 refs.

8810 (JINR-D—9-87-105-Vol.1, pp 390-393) **Characteristics of KUTI-20 electron-ion ring synchrotron radiation and prospects of its application.** Dolbilov, G.V.; Mal'tsev, A.P.; Sarantsev, V.P.; Sumbaev, A.P.; Tyutyunnikov, S.I.; Shalyapin, V.N. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Measurements of SR spectra in the adjacent IR-region were performed at the KUTI-20 accelerator using MDR-2 monochromator in 0.7-2.5 μm range. The device resolution is 150. Applicability area of the observed IR-radiation is demonstrated, which includes works related to IR-radiation detector calibration; radiation materials science works on measuring the material characteristics in IR-region (transmission and reflection coefficients); works connected with investigation into semiconducting material streucture, photoconductivity process study. Collective accelerator electron rings may also serve as an effective raiation source in the vacuum ultraviolet spectral region. 9 refs.; 4 figs.; 1 tab.

8811 (JINR-D—9-87-105-Vol.1, pp 23-44) **Main results of the 13. International conference on high energy particle accelerators.** Dzhelepov, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Status and densities of development of high-energy accelerators of the USSR, USA, Western Europe, Japan by the results of the 13-th International Conference, 1986 are reviewed. Data on superconducting resonators for electron accelerators are given. New schemes of acceleration permitting to obtain gradients of the accelerating field of the order of several hundreds MeV/m ensuring the possibility of developing linear accelerators for energies of the order of TeV are described in brief. Laser-plasma schemes, two-beam, wake-field schemes, etc. are considered. Designs of kaon-antiproton factories are being developed at present. 14 figs.; 13 tabs.

8812 (JINR-D—9-87-105-Vol.1, pp 201-204) **Start-up of the Uragan-1 small-size proton linac.** Balovnev, G.A.; Val'dner, O.A.; Gass, V.F. and others. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The description and parameters of the Uragan-I 140 keV 50 mA proton linear accelerator designed for the national economy, are presented. Duoplasmatron with directly heated cathode is the proton source. Ion-optical system consists of four series electrodes. 4 refs.; 4 figs.

8813 (JINR-D—9-87-105-Vol.1, pp 205-208) **Multibeam linear resonance ion accelerator.** Abramenko, N.I.; Baev, V.K.; Belousov, V.V. and others. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of theoretical and experimental investigations, conducted in the course of construction of multibeam linear resonance ion accelerator with axisymmetrical alternating phase-focusing are presented. The accelerator is made in classical scheme: multibeam source, transport and matching channel, accelerating section, connected with generator using RF-channel and high-voltage and high-frequency power supply system. Multibeam ion injector is a high-frequency source, where the dischange chamber is placed in high-frquency coaxial spiral resonator under high voltage, 100 kW. Multichannel accelerating structure is a modification of double-wire cylindrical resonator, where replaceable accelerating module is set. Construction of high-frequency power supply system is underway to-day. Functional models of separate accelerator units are made. Dependences of Ar and H/sup +/ ion current on voltage are presented. 6 refs.; 2 figs.

8814 (JINR-D—9-87-105-Vol.1, pp 209-220) **New trends in RFQ-development.** Schempp, A. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Angewandte Physik). 1987. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

New trends in RFQ-development depending on the design goals are presented. Designs for heavy ion RFQs and for highly charged light ions from EBIS source are given. The use of the RFQ to accelerate beams, to accelerate very heavy clusters is shown. The application of the procedure funnel beams with RFQs is outlined. The beam dynamic parameters of the 4-vane RFQ for HERA are given. 23 refs.; 19 figs.

8815 (JINR-D—9-87-105-Vol.1, pp 221-224) **High-power level test results of the main part of the LUMF module.** Esin, S.K.; Kiselev, I.V.; Kovalishin, A.S. and others. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Experimental bench-module of the MMF (Moscow meson factory) linear accelerator main part was made to conduct complex testings of MMF linear accelerator functional systems. Studies were conducted on the first accelerating resonator of accelerator main part (over 100 MeV). Resonator consists of four accelerating sections on the base of structure with conducting washers and diaphragms. Due to vacuum training of resonator at RF-power increase up to 2.5 MW the maximum vacuum lower than 1x10/sup -5/ Pa is obtained at 6x10/sup -7/ Pa/s leaking and at the absence of high-voltage discharges. In the course of complex testings stability of resonator operation modes and measurement of parameters of functional systems of LUMF main part experimental bench-module were provided. 4 refs.; 2 figs.

8816 (JINR-D—9-87-105-Vol.1, pp 243-245) **Accelerating structure for a proton linear resonance accelerator with low injection energy.** Bondarenko, P.V.; Danilov, V.D.; Il'in, A.A.; Pronin, A.N.; Sobenin, N.P. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Description of the 500 keV small-sized proton accelerator with 30 keV injection energy, developing for electronic industry, is presented. Oncoming bar resonator, excited at $\pi$-type oscillations, is used as accelerating structure . The length of accelerating structure is 600 mm. The main design parameters of accelerator are given. 5 refs.; 4 figs.

8817 (JINR-D—9-87-105-Vol.1, pp 140-142) **Peculiarities of a superconducting cyclotron with combined system of beam extraction.** Burbeza, K.D.; Venikov, N.I.; Lavrov, N.A.; Leonov, V.V.; Khodakov, E.M.; Yudin, L.I.; Yarosh, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Peculiarities of a superconducting cyclotron being developed in IAE are described. To produce 20-30 MeV proton beams the mode of H/sub 2//sup +/ molecular hydrogen ion acceleration to double enegy will be used. Stripping of H/sub 2//sup +/ ions at a thin stripper will be used to extract the proton beam. Geometry of magnetic system for magnetic field shaping is shown. Combined

system of pumping will be used for the vacuum improvement. 3 refs.; 3 figs.

8818 (JINR-D—9-87-105-Vol.1, pp 160-163) **Complex tuning of a multicharged ion linear accelerator.** Bomko, V.A.; Rudyak, B.I.; Kobets, A.F. and others. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Parameters and results of multicharged ion linear accelerator adjustment are presented. The accelerator is designed for ion acceleration from He to Ar up to the energy of 8.5 MeV/nucleon. In the process of adjustment He/sub 4//sup 2+/ ions were accelerated and the power of 0.4 MW fed the resonator. The current of helium ion was 20 mA. During adjustment drift tubes with grid focusing were used. 5 refs.; 3 figs.; 1 tab.

8819 (JINR-D—9-87-105-Vol.1, pp 175-181) **Present status of construction of Moscow meson factory high-current linear accelerator of the Institute for Nuclear Research, A.N. USSR.** Andreev, A.G.; Bondarev, B.I.; Esin, S.K. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Present status of the construction of hydrogen ion linear accelerator of the Moscow meson factory is described. The linear accelerator comprises proton injector, hydrogen negative ion injector and hydrogen polarized ion injector, as well as the 100 MeV linear accelerator with drift tubes and (100-600) MeV linear accelerator, using accelerating structure with washers and diaphragms. The accelerator length is 450 m. Nowadays the proton injector is mounted and 80 mA proton pulse current is obtained. At the benches of RF channel of the initial part of the accelerator the nominal pulse RF power of 4 MW is obtained. The mode of power input into a four-sectional resonator is studied. Tests of the injector beam shaping resonators are conducted. The major part (80 %) of special technological equipment is produced and mounted. It is shown that geometrical and radiotechnical parameters of the accelerator main units correspond completely to the requirements of beam dynamics. 20 refs.; 11 figs.

8820 (JINR-D—9-87-105-Vol.1, pp 182-189) **Results of RF-tuning of the LUMF accelerating sections.** Esin, S.K.; Kravchuk, L.V.; Paramonov, V.V.; Puntus, V.A.; Romanov, G.V.; Tarasov, S.G. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Technique and results of radiotechnical tuning of accelerating sections in the high-energy part (100-600 MeV) of the Moscow meson factory linear accelerator are presented. The accelerator comprises 110 sections of the structure with conducting washers and diaphragms. The tuning presupposes two main stages: the tuning of frequency characteristics and flattening of the accelerating field distribution over the section length. Frequency tuning is performed in two-three steps by the washer diameter decrease. The accelerating field flattening is attained by the displacement of all washers in the longitudinal direction at the expense of a slight deformation of the rods. Results of the linear accelerator radiotechnical tuning have shown that all the accelerating sections satisfy the requirements and are ready for operation. 12 refs.; 5 figs.

8821 (JINR-D—9-87-105-Vol.1, pp 190-192) **Linear accelerator for a continuous action racetrack microtron.** Alimov, A.S.; Artyukh, I.G.; Grishin, V.L.; Ishkhanov, B.S.; Sorvin, V.M.; Ushkanov, V.V.; Zverev, B.V.; Sandalov, A.N. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR); Moskovskij Gosudarstvennyj Univ. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The description and test results of linear accelerator biperiodic structure for the 110 MeV, 100 μA racetrack microtrons are presented. The cooling of the accelerating structure is realized by means of 40 channels 40 mm in diameter with cold water. The input of RF power is performed via central cell into the waveguide of 72x34 mm cross section. The effective shunt resistance is 74 MOhm/m. The accelerating section resonance frequency shift at the expense of thermal deformations is 500 kHz/kW/cell. 7 refs.; 4 figs.

8822 (JINR-D—9-87-105-Vol.1, pp 257-259) **Experimental study of linear resonance accelerator beam subacceleration in a passive resonator system.** Vishnyakov, V.A.; Zakutin, V.V.; Kushnir, V.A.; Romas'ko, V.P.; Fursov, G.L.; Shenderovich, A.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Possibility of production of intense accelerating fields in a system of passive resonators excited by linear resonance accelerator electron beam is experimentally investigated. The accelerator beam with the pulse current of 200 mA and energy of 10 MeV was transported along the axis of a chain of 7 passive resonators tunned to the second harmonic of electron bunch repetition frequency. To carry out additional acceleration a part of the beam particles in the pulse is 180 deg phase-shifted by extending their trajectory in deflector system of four pulse magnets. Deceleration of direct beam and acceleration of the beam passing the deflector was observed in experiments. Particle acceleration by 1.8 MeV due to deceleration of other particles by approximately 2 MeV is shown to take place. Difference in 0.2 MeV is due to a certain drop of a field in passive resonators for the period of deflector pulse front. The obtained results display prospects and possibility of practical realization of the given phase shift and beam additional acceleration method. The pulse duration being several microseconds and more high efficiency of the beam energy may be obtained by multiple deflector switch-on and off. 9 refs.; 3 figs.

8823 (JINR-D—9-87-105-Vol.1, pp 274-276) **New HF accelerating system of the B-3M injector accelerator of the VEPP-2 complex.** Kurkin, G.Ya.; Belomestnykh, S.A.; Petrov, V.M.; Krutikhin, S.A.; Lebedev, N.N.; Klimin, P.A.; Turkin, V.F. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

HF system of the B-3M electron synchrotron earlier operating at third repetition frequency harmonic (III MHz) is transferred to the first harmonic (37 MHz). This permits to increase an accelerated current, to extract from the B 3-M a short electron bunch and to carry out an accurate synchronization of injection. This results in increase of particle accumulation rate in the VEPP-2. An accelerating resonator, feeder line and control system are anew manufactured. The 37 MHz power generator is constructed using elements of earlier operating generator. The modernized HF system was produced in the beginning of 1985 and at present is in operation. 1 ref.; 3 figs.

8824 (JINR-D—9-87-105-Vol.1, pp 394-397) **Space-stretched betatron.** Aleksakhin, Yu.I. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A scheme of an "elongated" or "stretched" betatron is considered to increase accelerated electron current up to > or approx. 1 kA. The magnetic field in this device is created by two extended coaxial solenoids, one of which is constructed inside the other, and is fed by alternative current. Superposition of a space growing static field of the betatron type and a pulse magnetic field ("piston") of small intensity accelerating and simultaneously advancing electrons to a strong static field is used. Advantages of such a scheme are caused by the fact that vortex emf is created due to displacement of space-localized "piston", but not due to increase of solenoid current in time. Intensity of the electron beam at the output is determined by the number of electrons in ring N/sub e/ and by operation frequency. Time of acceleration equals 0.5 ms at the rate of "piston" motion - 3.5x10/sup -5/ and accelerator length - 5 m. The calculational current of the accelerator for N/sub e/ =10/sup 4/ (1.25 kA), acceleration rate is 20 MeV/m. 8 refs.; 2 figs.

8825 (JINR-D—9-87-105-Vol.1, pp 260-262) **Resonator accelerator with power capacitance coupling and built-in generator tube.** Panasyuk, V.S.; Samoshenkov, Yu.K.; Simanovskij, M.F.; Filimonov, V.V.; Ivanov, S.A.; Potrakhov, N.N. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Optiko-Fizicheskikh Izmerenij, Moscow (USSR); Leningradskij Ehlektrotekhnicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

In resonator charged particle accelerators aimed at applied use, generator tubes and accelerating resonator are united in one structure. The given design was studied at resonator electron accelerator with sealed off accelerating resonator. Coaxial, half-wave resonator consists of two quarter-wave resonators electrodynamically coupled via accelerating gap capacitance. Generator tube anode is built in inner electrode of one resonator and cathode-grid assembly is placed at the corresponding resonator end wall. Tungsten target is fixed at the end of this electrode and controlled electron gun is built in another electrode. Inner electrode, bearing a target and tube anode, is cooled by water supplied through copper tubes. The accelerator beam maximal energy is 500 keV, the beam peak current being 1 A. The accelereator is aimed at using as bremsstrahlung generator in industrial radiography. The mass of the emitter is approximately 10 kg, the dimensions - 190 x 700 mm. 3 refs.; 1 fig.

8826 (JINR-D—9-87-105-Vol.2, pp 124-126) **Industrial applications with the GANIL heavy ion beam.** Bieth, C. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Possible applications of heavy ion beams of GANIL is reviewed. Principle of the irradiation beam line to produce membranes with thickness of several tens of microns is shown. Beam energies of 7-25 MeV/A are available at GANIL to allow a thin window between the vacuum and the roller. Treatment effect on the pore formation, measured during track etching is shown. 4 refs.; 4 figs.

8827 (JINR-D—9-87-105-Vol.2, pp 199-210) **Development and construction of heavy ion accelerators at GSI.** Angert, N. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Present status of the GSI heavi ion sybchrotron (SIS) and experimental storage ring project is given. UNILAC modification as a future synchrotron injector is reviewed. Beam parameters of the CHORDIS ion source are given. The design of the MEVVA ion source is shown. Parameters of experimental storage ring electron cooler are presented. The site for the new facility is presently being prepared. Construction of the buildings starts in November 1986. Installation of accelerator components should start begin of 1988, and first beam tests at the SIS begin of 1989. The ESR will be completed about one year later than the SIS. 18 refs.; 13 figs.

8828 (JINR-D—9-87-105-Vol.2, pp 211-220) **Recent developments at TRIUMF.** Dohan, D.A. (TRIUMF, Vancouver, British Columbia (Canada)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The status of the TRIUMPH kaon factory is described. The preposed layout of the facility is shown. Outline of the rf deflector cavity to reduce beam losses from an extraction septum is given. Results of flattopping the TRIUMPH RF cavity is given. A diagram of the control system is shown. A dc multicusp ion source using a magnetic filter to enhance the volume production of ions has been developed for the TRIUMPH cyclotron. The M15 muon secondary channel and experimental hall has been constructed and commissioned at TRIUMPH. A view of the channel is given. 18 refs.; 11 figs.; 1 tab.

8829 (JINR-D—9-87-105-Vol.2, pp 421-429) **Superconducting separated orbit cyclotron Tritron.** Trinks, U. (Technische Univ. Muenchen (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

At the Munich Accelerator Laboratory the Tritron is under construction. It will be a booster for the existing MP tandem for the acceleration of heavy ions to specific energies up to {similar←to} 20 MeV/u. The Tritron is a modern design of the separated orbit cyclotron with the magnets as well as the accelerating cavities superconducting. It is projected to be a prototype to demonstrate the feasibility of this type of cyclotron, which may be suited to overcome some limiting effects of the conventional cyclotron conception. There will be no axial focusing problems. In addition longitudinal focusing occurs. There are no injection and extraction problems at all. Thus continuous ion beams of high intensity and high quality with energies up to about {similar←to} 600 MeV/u for Q/A=0.5 seem within reach by connecting several separated orbit cyclotrons with increasing radii in series. 9 refs.; 12 figs.

8830 (JINR-D—9-87-105-Vol.2, pp 91-99) **High-voltage accelerators for industrial application.** Glukhikh, V.A.; Svin'in, M.P.; Fedotov, M.T.; Vojnalovich, O.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Electron high-voltage accelerator design variations aimed at radiation technology and produced both by foreign firms and in the USSR are considered. The tendency to high-voltage accelerator development in the USSR is shown. Great attention is paid to design of the "Aurora"-type accelerators with 200-750 keV electron energy and up to 100 kW beam power. 22 refs.; 5 figs.

8831 (JINR-D—9-87-105-Vol.2, pp 100-104) **Applied works on the U-120 cyclotron.** Bel'skij, E.M.; Bojko, A.N.; Grantsev, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Two applied trends of the U-120 cyclotron application are described. A new promising trend of neutron radiotherapy is developed at the U-120 cyclotron. The results of development of the

proximate nondestructive method of protein (nitrogen) analysis using the nuclear reaction are presented. The cyclotron on-line control system created nowadays is described. Works on accelerator modernization are described. 5 refs.

8832 (JINR-D—9-87-105-Vol.2, pp 105-108) **High-current betatrons of the Tomsk Polytechnical Institute and their application.** Akimov, Yu.M.; Akimochkin, Yu.V.; Akulov, G.V. and others. (Tomskij Politekhnicheskij Inst. (USSR). Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Works on improvement of designed earlier and consumption of new high-current betatrons have been carried out at the Tomsk Polytechnical Institute for last several years. Special attention has ben paid to increase of accelerator specific characteristics: decrease of their weight and sizes, increase of reliability and irradiation dose rate at the output. It has been reached due to application of the packaged design of the betatron electromagnet, joining of such elements as an electron gun and a pulse transformer into a single assembly, increase of the injection energy and the acceleration repetition rate. Main 25, 30 and 50 MeV betatron performances are given. 2 refs.; 2 figs.; 1 tab.

8833 (JINR-D—9-87-105-Vol.2, pp 109-112) **Intense ion beam production and formation in a high-voltage accelerator.** Voronin, G.G.; Vyaz'menova, G.A.; Komarov, O.L. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results of investigation on 100 mA current hydrogen ion beam production and formation in a high-voltage accelerator with 250-300 keV energy are considered. A duoplasmatron has been chosen as a ion source. Experimental investigations of charged particle intense flux formation have shown that the optical system chosen provides a focusing beam at the distance of 2 m from the accelerating tube output with 100 mA current and current density distribution close to Gaussian one with the full width half maximum of 1-2 cm and losses in the slit with 50 mm hole, being in front of a current-collector are 1-2 mA. Stable operation of the accelerating tube took place at 1 mA current for an accelerating electrode. 7 refs.; 3 figs.

8834 (JINR-D—9-87-105-Vol.2, pp 320-322) **Development and investigation of one-resonator superconducting electron accelerator.** Didenko, A.N.; Artemenko, S.N.; Kaminskij, V.L.; Nichinskij, N.A.; Samojlenko, G.M.; Yushkov, G.Yu. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The niobium one-resonator electron accelerator based on the split 10-cm resonator with throttle connection is developed and made. Main accelerator elements - an electron gun, an acclerating resonator and a magnetic spectrometer - are placed in the standard vertical helium cryostat. The accelerating current of the value of less than a microampere with the maximum of approximately 150 keV is obtained with 5x10/sup 8/ resonator quality factor. 1 ref.; 2 figs.

8835 (JINR-D—9-87-105-Vol.2, pp 400-402) **Increase of reliability of charged particle accelerators using radiative-stable materials.** Korenevskij, V.V.; Pokrovskij, K.K. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

To increase the reliability of the accelerator systems measures for the insulation of separate accelerator systems using electro-radiomaterials on the basis of polymers with the increased up to 5 x 10/sup 7/ Gy radioresistance are described. It is shown that the use of radioresistant materials is one of the most effective ways to increase the reliability of the accelerator systems. For the final choice of the materials, the laboriousness and technological efficiency of production of the corresponding elements, units and structures, should be taken into account. 15 refs.; 1 tab.

8836 **(KEK-PR—87-2) Photon Factory activity report, 1987.** (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). 1987. 386p. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88756075/JAW.

The Photon Factory made great strides in 1987. The low emittance operation of the PF ring was achieved in March, and resulted favorably in the increase of brilliance from 2 to 20 times for all the beam lines with high beam stability. At the same time, the installation of inserted devices was under way for all available straight sections of the ring. A 54-pole wiggler-undulator has been commissioned at BL-16. The devices to be inserted in the near future are a multipole wiggler for BL-13, an undulator for BL-19, and an undulator for circular polarized radiation at BL-28. The construction of beam lines continued, and four new beam lines, BL-6, BL-9, BL-16 and BL-17, are now in operation, BL-13 and BL-19 are under construction, and BL-3, BL-5, BL-18, BL-20 and BL-28 are in the design stage. Since its inauguration with four beam lines in 1982, the Photon Factory has grown rapidly, and approaches the goal of operating the PF ring with positrons in full use of its 24 beam ports and the straight sections for inserted devices. The total operation time was limited to 3,000 hours by the budget for fiscal year 1987, and about 80 % of the operation hours were devoted to the experiments of users. The nearly perfect operation of the 400 m long linac has continued in 1987, and has supplied both electrons and positrons to the TRISTAN collision experiment. The light source of a 2.5 GeV electron storage ring was normally operated. (Kako, I.).

8837 **(LBL—26073) A brief status report on the SLAC Linear Collider (SLC).** Goldhaber, G. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 5p. (CONF-8805229—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002963/JAW.

From 3. ESO-CERN symposium on astronomy, cosmology, and fundamental physics; Bologna, Italy (16 May 1988).

Some aspects of SLC operation and running conditions in 1988 are discussed. 4 refs., 3 figs., 1 tab.

8838 **Experimental demonstration of acceleration and focusing of magnetically confined plasma rings.** Hammer, J.H.; Hartman, C.W.; Eddleman, J.L.; McLean, H.S. (Lawrence Livermore National Laboratory, Livermore, California, 94550). *Physical Review Letters;* **61**: No. 25, 2843-2846(19 Dec 1988).

We have demonstrated acceleration of magnetically confined plasma rings in a coaxial accelerator, with acceleration of 0.02-mg ring masses to 1.4 x $10^8$ cm/sec at $\geq$30% efficiency. In some cases low mass rings have reached a velocity of 2.5 x $10^8$ cm/sec. When the accelerated rings translate into conical electrodes, we have observed focusing of rings by a factor of $\sim$3 in radius with a factor of $\geq$4 magnetic field amplification. A reasonably complete accounting of ring mass, momentum, and energy confirms the basic concept of acceleration of stable, well-confined magnetized plasma rings.

8839 **(DOE/EIS—0138-Vol.4-App.1,4,6,9,10,12-16) Superconducting Super Collider: Final environmental impact statement: Appendices 1, 4, 6, 9, 10, 12--16, Errata and revisions.** (USDOE, Washington, DC). Dec 1988. 171p. NTIS, PC A08 - OSTI. Order Number TI89004236/JAW.

This book contains Errata and Revisions for Volume IV, Appendices 1, 4, 6, 9, 10, and 12--16. Paragraphs are counted from the top of the page, e.g., Par. 1 begins with the first line on the page, whether that line is the actual beginning of a paragraph or not. Minor changes in tables and figures are described in the Errata

and Revisions sheets. Tables and figures that are new or corrected and republished are presented at the end of each appendix section.

8840 **The status of the Tevatron collider.** Peoples, J. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 493-528 of Physics in collision. Derrick, M. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-860943—).

From 6. international conference on physics in collision; Chicago, IL, USA (3 Sep 1986).

In the initial but preliminary agenda for this conference the authors' talk was included in the session entitled Near Future and Future Physics. This agenda seemed quite reasonable to the author because a largely constructed but uncommissioned collider seemed to be an appropriate subject for the Near Future. The SSC certainly belongs to the Future. One aspect of such a talk, is the content is not constrained by the reality of results. In the minds of experimenters the colliders of even the Near Future will be colliding at their design luminosities with negligible down time for failures. While the reality of the Tevatron collider run in the fall of 1985 is a constraint on any exaggerations that the author might be tempted to make, the author approaches the talk expecting to be one of several speakers proclaiming the rosiest future.

## 4302 Beam Dynamics, Field Calculations, And Ion Optics

*REFER ALSO TO CITATION(S) 8667, 8686, 8791, 8877, 9010, 9011, 9019*

8841 **(AD-A—197798/2/XAB) Microwave- and electron-beam computer programs. Final report, August 1986-January 1988.** Godfrey, B.B. (Mission Research Corp., Albuquerque, NM (USA)). Jun 1988. 31p. (AMRC-R—886). NTIS, PC A03/MF A01.

This report discusses some computer programs available for addressing the physics of high-power microwave- and charged-particle beam generation and propagation. Codes range from simple lumped parameter models to detailed multidimensional simulations. Described here are the capabilities and underlying models of the microwave source, particle beam accelerator, and particle-beam propagation codes. Although the more powerful of these programs can also be used for microwave propagation and antenna design, other programs specifically designed for these applications are typically employed instead.

8842 **(BNL—42074) Study of spin resonances in the accelerators with snakes.** Lee, S.Y. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 51p. (CONF-880983—20). NTIS, PC A04/MF A01 - OSTI. Order Number DE89004523/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

Spin resonances in the circular accelerators with snakes are studied to understand the nature of snake resonances. We analyze the effect of snake configuration, and the snake superperiod on the resonance. Defining the critical resonance strength $\epsilon$/sub c/ as the maximum tolerable resonance strength without losing the beam polarization after passing through the resonance, we found that $\epsilon$/sub c/ is a sensitive function of the snake configuration, the snake superperiod at the first order snake resonance, the higher order snake resonance conditions and the spin matching condition. Under properly designed snake configuration, the critical resonance strength $\epsilon$/sub c/ is found to vary linearly with N/sub S/ as $<\epsilon$/sub c/$> = (1/\pi)$sin/sup {minus}1/({vert←bar}cos $\pi\nu$/sub z/{vert←bar}/sup {1/2}/)N/sub S/, where $\nu$/sub z/ and N/sub S/ are the betatron tune and the number of snakes respectively. We also study the effect of overlapping intrinsic and imperfection resonances. The imperfection resonance should be corrected to a magnitude of insignificance (e.g., $\epsilon \leqq 0.1$ for two snakes case) to maintain proper polarization. 23 refs., 25 figs.

8843 **(BNL—42089) Accelerator physics in RHIC [Relativistic Heavy Ion Collider].** Claus, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-8806243—7). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004514/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

RHIC (for Relativistic Heavy Ion Collider) is a colliding beam facility to be built at BNL in the tunnel system that was constructed for the defunct ISABELLE/CBA project. It is intended for the study of collisions between fully stripped ions of the same or different species with magnetic rigidities of up to at least 839.5 Tm, corresponding with an energy of 100 GeV/amu (amu for atomic mass unit) for particles with A/Z = 2.5, and 251 GeV for protons. There are six potential crossing regions, each with, initially, time average luminosities of up to a few times $10^{26}$ cm$^{-2}$ sec$^{-1}$ for Au, with luminosity life-times of 10 hours for Au, and longer for the lighter ions. The initial proton-proton luminosity will be about $10^{31}$ cm$^{-2}$ sec$^{-1}$. The rms length of the interaction diamond is 0.2 m when the beams collide colinearly, it is determined by the lengths of the colliding bunches. The diamond length can be reduced by having the beams cross at an angle, but this reduces the luminosity. The magnitude of the crossing angle is restricted geometrically in dependence of the energies and species of the interacting ions and possibly also by dynamic effects in the circulating beams. The distance between each crossing point and the nearest machine component is 9 m on each side, this space is available for experimental equipment. The performance quoted assumes that each ring contains 57 bunches, each bunch with $10^9$ Au ions, resp $10^{11}$ protons and with invariant emittances of $10\pi$, resp $20\pi$ mm-mrad, and $\beta$/sub x/* = $\beta$/sub y/* = 3 m. The beam-beam tune-shift per crossing point at these intensities is 0.0025, resp 0.0037. 5 refs., 4 figs.

8844 **(CONF-8806282—1) Theory of intrabeam scattering in strong-focussing accelerators.** Mtingwa, S.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 39p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003649/JAW.

From 1. Edward Bouchet international conference on physics and technology; Trieste, Italy (9 Jun 1988).

Intrabeam scattering is the ultimate limitation on the luminosities of high energy proton and heavy ion accelerators. We review the theory of intrabeam scattering from the earliest theory, which was applicable to weak-focusing accelerators, to the latest strong-focussing theory proposed by Bjorken and Mtingwa. Comparisons of the theory to experimental data at several accelerators are given. Moreover, predictions are made for the effects of intrabeam scattering on the luminosities of the proposed upgraded Tevatron at Fermilab and of the recently proposed Superconducting Super Collider. 8 refs., 8 figs., 9 tabs.

8845 **(DOE/ER/40216—6) Accelerator research studies: Technical progress report, June 1, 1988--May 31, 1989.** (Maryland Univ., College Park (USA)). 1989. Contract AC05-85ER40216. 101p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89005020/JAW.

This report discusses research progress in the following general topics: Study of transport and longitudinal compression of intense, high-brightness beams; study of collective ion acceleration by intense electron beams and pulse powered plasma focus; and study of microwave sources and parameter scaling for high-frequency electron-positron supercollider linacs. (LSP)

8846 **(FRCEA-TH—89) Heavy ion acceleration by a linear system with independent superconducting cavities. Study and application of a helical niobium cavity with two accelerating zones. Determination of the fields and description of ion movement in the accelerator system.** Ramstein, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie; Paris-11 Univ., 91 - Orsay (France)). Mar 1987. 167p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756136/JAW.

We shall study the reasons why two or three gap structures have been chosen as accelerating cavities. At last we shall give the main advantages of the two gap structure. In a second part of this work, we have very accurately measured by the perturbation method the electromagnetic field distribution for the fundamental mode inside the cavity. Characteristics parameters as: shunt impedance, geometrical factor, Q value have been measured. From these

measurements we have optimized the helix geometry and estimated the energy gain per charge. The third part consists in measuring the liquid helium temperature properties of the cavity. The main parameter is then the Q value. We measured it at different field levels, and we used second sound wave propagation in superfluid helium to determine the spot position where the increase of temperature leads to quench. We have also estimated the RF losses due to the trapped magnetic flux (Meissner Effect). To realize construction prototype cavities we have investigated the resonance frequency dependance upon the geometrical parameters to be able to calculate and build a winding mandril for the helix to get a resonance frequency at an integer multiple of the beam frequency. The last part of this work consisted in tests of the prototype cavity with an ion beam we have checked the behaviour of the transit time factor and studied the optic along the beam transport line. In conclusion we present a comparison between the different choices to install these cavities in the booster under construction.

8847 **(FRCEA-TH—94) Coherent instabilities in circular accelerators.** Garnier, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service Charge de l'Entretien et du Fonctionnement de Saturne; Institut National Polytechnique, 38 - Grenoble (France)). Apr 1987. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756139/JAW.

Coherent instabilities in beams grouped in packets in circular accelerators are studied. The origin of the phenomenon lies in the electromagnetic field created by the interaction of the beam (characterized by its distribution), and the environment (modeled by its impedance). Coherent motion is defined in terms of oscillation modes. Phenomena appearing at high intensities are interpreted as coupling between modes seen at low intensity. The theory was applied to two machines to estimate their intensity limits: SUPER-ACO being built at Orsay, and The European Synchrotron Radiation Facility planned for Grenoble.

8848 **(INFN-TC—88-19) Preliminary design of the beam transport system for the Milan biomedical cyclotron.** Silari, M. (Istituto Nazionale di Fisica Nucleare, Milan (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 30p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704912/JAW.

This report illustrates the preliminary design of the beam transport system for the Scanditronix MC40 cyclotron to be installed in Milan. The Cyclotron will be dedicated to biomedical research and the different experimental conditions that could occur will require a beam transport system flexible enough so as to deliver beams with the specified characteristics. The report describes the computer codes used, the calculations performed and the results obtained. The complete configuration of the beam lines serving the first two target rooms is given, together with typical beam profiles and the emittance ellipse variation along the transfer channels.

8849 **(INS-J—172) Theory and design aspects of the 1 GeV proton compressor ring for pulsed beams of spallation neutrons and muons.** Rees, G.H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1988. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756046/JAW.

In the present paper, an outline design is presented for a 50 Hz, 1 GeV proton compressor ring of Japanese Hadron Project. The design aims are to provide two pulses of 1 GeV protons with an average current of 200 μA, one pulse with the time duration of 20 ns and the other of 100 - 200 ns. Very important aspects of magnet lattice, injection scheme, bunch compression process, beam instabilities are discussed.

8850 (JINR-D—9-87-105-Vol.1, pp 90-91) **Program package for on-line correction of charged particle beams direction and focusing.** Volkov, B.S.; Samojlov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An algorithm and a program package for correction of charged particle beam direction and focusing is described. Correction of focusing properties of the accelerator magnetooptical system is based on computation of corrections for the quadrupole lense gradients. The program package functioning is possible in two modes: automatic and "manual", dialogue. 5 refs.

8851 (JINR-D—9-87-105-Vol.1, pp 379-381) **Transverse focusing of a beam in an ondulator accelerator.** Masunov, Eh.S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The work is aimed at sequential accounting of charged paricle interaction with the electromagnetic field of a travelling or standing wave in a quasiperiodic arbitrary ondulator. Several examples of ondulator accelerator realization are considered and conditions for the beam focusing are found. It is shown that it is not necessary to use additional focusing fields in the ondulator accelerator to provide for transverse beam stability under the beam bunching and acceleration. However, in this case it is necessary to maintain certain relations between electromagnetic wave field and ondulator field amplitudes, which depend on the accelerator type. 6 refs.

8852 (JINR-D—9-87-105-Vol.1, pp 382-385) **Dynamics of modulated relativistic electron beam radiation field accumulation in decelerating systems with feedbacks.** Ajzatskij, N.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Dynamics of modulated relativistic electron beam radiation field acceleration in decelerating systems with feedbacks is theoretically and experimentally investigated. Experimental testing of dynamics of interaction of the modulated relativistic electron beam with the travelling wave resonator was conducted at the second section of the universal injector complex of the LUEh-300 accelerator of the KhPTI of the Ukrainian Academy of Sciences, which is characterized by the presence of external feedbacks in the system of SHF-supply of all the four acceleration sections. It is shown that that the process of radiation field accumulation in decelerating structure with feedback may become unstable. In this case automodulation phenomena, impeding the realization of the autoacceleration methods proposed in the energy range of (10-15 MeV) occur. 5 refs.; 3 figs.

8853 (JINR-D—9-87-105-Vol.1, pp 232-234) **Peculiarities of intense beams acceleration in multiresonator structures.** Vorogushin, M.F.; Malyshev, V.N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR); Leningradskij Ehlektrotekhnicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Description of technique for investigation of dynamic mode of intense beam acceleration in multiresonator structures of standing wave linear electron accelerators is presented. Expressions for amplitudes of waves excited by generator and beam in accelerating structure, are obtained. Multiresonator structure peculiarities are shown, the main peculiarity is the occurrence of critical value of beam rated current, at the excess of which energy increase is negative even at optimal matching of the beam-loaded structure. It is shown, that for intense beam acceleration in such structures it is advisable to use structures with strong intercellular coupling, in particular, structure with washers and diaphragms. 3 refs.; 3 figs.

8854 (JINR-D—9-87-105-Vol.1, pp 270-273) **Particle losses due to beam-resonator interaction in a synchrotron during injection.** Karliner, M.M.; Pekker, M.S.; Turkin, V.F.; Fomel', B.M.; Yakovlev, V.P. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The B-3M high-current weak-focusing synchrotron is part of the VEPP-2 complex. Acceleration in the B-3M is carried out in two stages. It is stated that the main limitation for accelerating current value is defined by the beam particle losses at the first acceleration stage. In this connection peculiarities of dynamics of accelerated in betatron mode beam interacting with passive RF-resonator are considered. Experimentally obtained the beam current time dependences with different RF-resonator detuning value are in a good agreement with the calculations. 3 refs.; 4 figs.

8855 (JINR-D—9-87-105-Vol.1, pp 409-410) **Multimode theory of beam breakup in a linear accelerator.** Burov, A.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Relativistic electron beam current distribution in a linear accelerator is considered in the multimode approximation taking into account the contribution of higher harmonics. 5 refs.

8856 (JINR-D—9-87-105-Vol.1, pp 416-418) **Space charge resonance effects in strong-focusing channels for charged particle transport.** Danilov, V.D.; Zobov, M.M. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

INstability of beam "envelopes" is considered to increase beam intensity in linear accelerators and transport channels. "Nonlinear envelope resonances", when the beam emittance growth will be their consequence, can occur in the region with $\mu/sub\ 0/<90$ deg ($\mu/sub\ 0/$ is the superposition of the particle transverse oscillation phase in the accelerating-focusing channel). The results of numerical simulation of beam dynamics by the "large" particle method are presented. It is shown that "nonlinear resonance of the beam envelope" is due to the space charge collective effect with unharmonic dependence of density on time for dismatched beam and is not due the space charge nonlinearity or external effects. For separate particle "nonlinear resonance of beam envelope" is developed in combinational resonance due to the presence of space charge subharmonic of the external (focusing) force in the field. 3 refs.; 4 figs.

8857 (JINR-D—9-87-105-Vol.1, pp 421-425) **Peculiarities of intense beam radial dynamics in multisectional electron linacs.** Kalashnikov, V.V.; Pal'mskaya, M.L.; Petrenko, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Some investigation results of beam transverse phase volume deformation with current of several ampere pulse under stationary condition of linear accelerator "Fakel" are considered. Radial dynamics is considered in the accelerator regions: the electron gun - a waveguide buncher, a waveguide buncher and the region with regular accelerating waveguides. Causes of current limitation and optimal conditions of performance are determined in every region. On the basis of experimental data and simulation the conclusions have been made that designs, aimed at accelerator current increase and improvement of beam quality, are to provide beam emittance decrease after bunching waveguides, for which decrease of the phase width and energy spread of the bunch in the process of its formation and application at the input if the buncher of the electron gun with a small phase beam volume, and acceptance of the regular accelerator part and expansion of possibilities of beam emittance matching with acceptance of the regular accelerator part, are more radical. 11 refs.; 3 figs.

8858 (JINR-D—9-87-105-Vol.1, pp 426-428) **On radial stability of a beam in a waveguide buncher of an electron linac.** Kalashnikov, V.V.; Petrenko, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results of analytical and experimental investigations of dynamics of the electron axial-symmetrical beam when passing of the bunching section of the linear accelerator are presented. The investigations showed that, in site of limitedness of the electron linac region, where radial instability is observed, parametric action leads to increase of beam phase volume, restricts the efficiency of beam matching with the regular accelerator part and, finally, affects considerably the intensity and quality of accelerated beam shaping. 5 refs.; 2 figs.

8859 (JINR-D—9-87-105-Vol.1, pp 429-431) **About one possibility of realization of a flat ondulator and strong-focusing magnetic lense.** Ogandzhanyan, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Stability of electron beam motion in a flat ondulator is considered. Depending on relative direction of currents in conductors, the ondulator magnet can be used as a strong-focusing lens. Stability of beam motion relative to the equilibrium trajectory in the flat ondulator is shown. 2 refs.

8860 (JINR-D—9-87-105-Vol.1, pp 432-435) **Study on particle dynamics in the 4,5 GeV continuous action high-current electron accelerator.** Belovintsev, K.A.; Bessonov, E.G.; Karev, A.I.; Kurakin, V.G.; Levonyan, S.V.; Serov, A.V. (AN SSSR, Moscow. Fizicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A polytronic scheme of electron acceleration up to 4.5 GeV energy is suggested in the Physical Institute of the USSR Academy of Science. The usual racetrack microtron is supposed to be used in the first cascade of this accelerator, the bilateral microtron - in the second cascade, octatron - in the third cascade, i.e. polytron of the 4th order accelerating electrons from 1 GeV energy up to the final 4.5 GeV energy. In general case polytron of the N-order represents a cyclic accelerator consisting of N elements of periodicity, every of which includes the accelerating structure and two mirror-symmetric regions of the constant magnetic field of the segment-type. Octatron optics is proved, and effect of synchrotron radiation on the parameters of the accelerating beam is also estimated. Problems considered and estimations made show principal feasibility of the accelerator design suggested by the Institute. 5 refs.; 2 figs.

8861 (JINR-D—9-87-105-Vol.1, pp 436-439) **Numerical simulation of phase motion in a continuous-action racetrack microtron.** Grishin, V.K.; Sotnikov, M.A.; Shvedunov, V.I. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A new approach to analysis of phase motion in a racetrack microtron based on asymptotically equilibrium particle notion is suggested. Results of numerical simulation of phase motion in a racetrack microtron permitting to determine phase trajectory of equilibrium particle for designed injection energy, separatrix form and position, the value of longitudinal acceptance, to estimate the

injected beam parameters for attaining the designed monochromatisity in racetrack output are presented. 2 refs.; 2 figs.; 2 tabs.

8862 (JINR-D—9-87-105-Vol.1, pp 440-443) **Electron beam dynamics in a high-current betatron and determination of accelerator parameters using HF radiation generated by the beam.** Moskalev, V.A.; Tsimbalist, A.V. (Tomskij Politekhnicheskij Inst. (USSR). Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Study of electron beam microwave radiation spectrum aimed at determination of accelerator and electron beam parameters was carried out in a high-current betatron and in cylindrical betatron model. Using radius of equilibrium orbit and magnetic field drop coefficient previously obtained from static magnetic measurements an expected range of electron repetition frequency and radial and axial betatron oscillation frequency in studied accelerator were determined. High frequency parameters (resonance frequencies, quality) of betatron accelerating chamber without a beam were investigated by excitation of its cavity with HF-generator. Measurements of frequency spectrum of electromagnetic oscillations excited during electron injection showed that at any moment a spectrum is generated which minimum frequency is proportional to maximal energy of injected electrons, and maximum frequency corresponds to minimum energy. Electromagnetic oscillation frequency spectrum permits to determine position of electron beam in a phase space. 7 refs.

8863 (JINR-D—9-87-105-Vol.1, pp 444-445) **On distribution of phase density in a beam with space-charge nonlinear transverse field.** Budanov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

In studying the problems on self-consistent dynamics in 4-dimensional phase space for longitudinally uniform beams with nonlinear transverse proper field the arising mathematical difficulties result in an extremely limited number of accurate solutions of the problem even in case when smooth approximation is used. In frames of this approximation a new solution of this problem is obtained, and a number of properties of the beams with nonlinear fields based on suggested method is investigated. 2 refs.

8864 (JINR-D—9-87-105-Vol.1, pp 446-447) **On the solution of the Vlasov equation for an uniformly charged ellipsoidal bunch.** Budanov, Yu.A.; Shvetsov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Three classes of self-consistent distributions for an uniformly charged ellipsoidal bunch are constructed to study the beam dynamics taking account of the space charge. The presented approach may be used in a problem on self-consistent distributions in 4-dimensional phase space axial motion referring to the beams with elliptical configuration. 6 refs.

8865 (JINR-D—9-87-105-Vol.1, pp 448-451) **Simulation of fields and particle dynamics in an ion linear accelerator with an axially-nonsymmetric accelerating structure.** Bukharin, V.L.; Kozlov, V.P.; Krasnoborod'ko, A.A.; Seliverstov, S.Yu. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An approach to beam dynamics simulation in ion linear accelerators with an axially-nonsymmetric accelerating structures is considered. An algorithm and results of test calculations of cylindrical resonator are presented. Calculations were carried out using the CM-4 computer FORTRAN program. 8 refs.; 1 tab.

8866 (JINR-D—9-87-105-Vol.1, pp 456-458) **Perturbation of particle cyclic motion by smooth and stochastic components of beam proper field.** Arutyunyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Relativistic circulating beam proper field have smooth and stochastic components. It is shown that smooth component and external fields effect restrict allowance for application of rectilinear Born approximation for mean order distances between beam particles. Effect of the field stochastic component is also substantial and must be taken into account during design and construction of cyclic accelerators and storage rings with ultrarelativistic beams. 6 refs.

8867 (JINR-D—9-87-105-Vol.1, pp 459-460) **Increase of focusing long-range interaction.** Moroz, E.M.; Shorin, K.N. (AN SSSR, Moscow. Fizicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Admissible betatron oscillation stability requirements, ratio between length l of each of N rectilinear intervals and orbit curvature radius r in weak-focusing racetrack sectors quantitatively characterizes long-range focusing of accelerated particles in such type magnetic systems. It is shown that legitimate value l/r in weak-focusing racetrack may be increased by variation of n values in magnet sectors, where n - index of magnetic field drop in sectors. 1 ref.; 3 figs.

8868 (JINR-D—9-87-105-Vol.1, pp 250-253) **Longitudinal matching of a beam in an ion linear accelerator during multiple variation of HF-field frequency.** Pashen'kov, A.S.; Senichev, Yu.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

In proton linear accelerators (LA) the beam acceleration exceeding 100-200 MeV requires use of other accelerating structure. Corresponding to accelerating field frequency variation decrease of phase region of the LA 2nd part capture region in the 1st part phase scale specifies requirements for beam parameters at transition section. For matching of a beam with the LA 2nd part rebunching devices (matching resonators) operating at the frequency of both the 1st and the 2nd accelerator part are used. Decrease of particle losses in the process of their acceleration in the LA second part is possible with application of the beam feedback automatic control systems(ACS). One of such devices is a coherent phase oscillation suppression system. Coherent oscillations of bunch centers with further acceleration in the LA second part may be eliminated by use of time flight procedure of tuning LA high-energy part multisectional resonators. 4 refs.; 1 fig.

8869 **(KEK—87-30) Application of circular polarized synchrotron radiation.** Miyahara, Tsuneaki; Kawata, Hiroshi (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Mar 1988. 133p. (In Japanese). (CONF-8711257—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756072/JAW.

From Workshop on application of circular polarized synchrotron radiation; Tsukuba, Japan (16 Nov 1987).

The idea of using the polarizing property of light for physical experiment by controlling it variously has been known from old time, and the Faraday effect and the research by polarizing microscopy are its examples. The light emitted from the electron orbit of an accelerator has the different polarizing characteristics from those of the light of a laboratory light source, and as far as observing it within the electron orbit plane, it becomes linearly polarized light.

By utilizing this property well, research is carried out at present in synchrotron experimental facilities. Recently, the technology related to the insert type light cources using permanent magnets has advanced remarkably, and circular polarized light has become to be producible. If the light like this can be obtained with the energy not only in far ultraviolet region but also to x-ray region at high luminance, new possibility should open. At the stage that the design of an insert type light source was finished, and its manufacture was started, the research on the method of evaluating the degree of circular polarization and the research on the utilization of circular polarized synchrotron radiation are earnestly carried out. In this report, the results of researches presented at the study meeting are summarized. Moreover, the design and manufacture of the beam lines for exclusive use will be carried out. (Kako, I.).

8870 **(LBL—25891) Simulation of emittance growth in the ALS [Advanced Light Source] pre-injector.** Kim, C.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 3p. (CONF-881049—49). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004652/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Transverse and longitudinal beam dynamics in the ALS preinjector were simulated with a 2 1/2 D code. Strong space charge-forces at low energy and nonlinearities caused emittances to grow. However, careful tuning of the bunching system and the linac reduced emittance growth to an acceptable label. About 1/3 of the gun output are within the required energy spread and the normalized rms emittance is significantly lower than the expected value. 3 refs., 7 figs., 1 tab.

8871 **(LBL—25902) Acceleration, current amplification and emittance in MBE-4, an experimental beam induction linear accelerator for heavy ions.** Warwick, A.I.; Gough, D.E.; Keefe, D.; Meuth, H. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 3p. (CONF-881049—51; HIFAN—404). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004790/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

We report on the implementation of a second schedule of acceleration and current amplification in MBE-4. Control of the beam current within the bunch is improved over that in the first schedule by the addition of several small amplitude induction pulsers to compensate for acceleration errors and to control the ends of the bunch. Measurements of the longitudinal and transverse emittance are presented. 5 refs., 3 figs., 1 tab.

8872 **(LBL—26050) Rf and space-charge induced emittances in laser-driven rf guns.** Kim, Kwang-Je; Chen, Yu-Jiuan. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 3p. (CONF-881049—48). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004693/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Laser-driven rf electron guns are potential sources of high-current, low-emittance, short bunch-length electron beams, which are required for many advanced accelerator applications, such as free-electron lasers and injectors for high-energy machines. In such guns the design of which was pioneered at Los Alamos National Laboratory and which is currently being developed at several other laboratories, a high-power laser beam illuminates a photo-cathode surface placed on an end wall of an rf cavity. The main advantages of this type of gun are that the time structure of the electron beam is controlled by the laser, eliminating the need for bunchers, and that the electric field in rf cavities can be made very strong, so that the effects due to space-charge repulsion can be minimized. In this paper, we present an approximate but simple analysis for the transverse and longitudinal emittances in rf guns that takes into account both the time variation of the rf field and the space-charge effect. The results are compared and found to agree well with those from simulation. 7 refs., 6 figs.

8873 **(SLAC-PUB—4810) Quantum beamstrahlung: Pulse shaping prospects for a photon-photon collider.** Blankenbecler, R.; Drell, S.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 11p. (CONF-8806243—9). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004971/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

Beamstrahlung is the fraction energy loss to radiation as one beam pulse is accelerated by the electromagnetic field of the other pulse through which it passes in a collider. In linear colliders the individual pulses must be formed with much larger charge densities to compensate for their much lower rate of interactions ($10^2$ – $10^3$ per second) in comparison to storage rings (typically $10^5$ per second). Therefore the electromagnetic fields generated by the charges in each pulse will be correspondingly larger, as will the acceleration they induce in the charges of the intersecting pulses; this in turn leads to a larger loss of energy to radiation. In this report we consider three questions: What is the quantum result for beamstrahlung and when is the classical result valid? How does the transverse beam geometry{emdash}i.e., ribbon versus cylindrical pulse{emdash}affect the beamstrahlung? Extending the quantum calculation to multiple photon emission, what is the photon flux and what are the prospects for a photon-photon collider? 3 refs., 2 figs.

8874 **(SLAC-PUB—4812) The use of electromagnetic particle-in-cell codes in accelerator applications.** Eppley, K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1988. Contract AC03-76SF00515. 6p. (CONF-881049—46). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004968/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The techniques developed for the numerical simulation of plasmas have numerous applications relevant to accelerators. The operation of many accelerator components involves transients, interactions between beams and rf fields, and internal plasma oscillations. These effects produce non-linear behavior which can be represented accurately by particle in cell (PIC) simulations. We will give a very brief overview of the algorithms used in PIC Codes. We will examine the range of parameters over which they are useful. We will discuss the factors which determine whether a two or three dimensional simulation is most appropriate. PIC codes have been applied to a wide variety of diverse problems, spanning many of the systems in a linear accelerator. We will present a number of practical examples of the application of these codes to areas such as guns, bunchers, rf sources, beam transport, emittance growth and final focus. 8 refs., 8 figs., 2 tabs.

## 4303 Auxiliaries And Components

*REFER ALSO TO CITATION(S) 8172, 8274, 8793, 8794, 8862, 8872, 9501, 9855, 10229*

8875 **(AECL—9112) Electron test accelerator beam injector.** Labrie, J.-P.; Bird, R.T.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1986. 40p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704986/JAW.

A beam chopper and buncher system has been designed to improve the capture efficiency and reduce the beam spill in the Electron Test Accelerator. The buncher increases the dc beam capture from 30 to 70%. 100% beam transmission through the accelerator structures is obtained with the chopper. This report describes results of experimental tests with the beam injector. Results from computer modeling and from measurements with prototypes that have led to the design of the beam chopper and buncher system are discussed.

8876 **(ANL-HEP-CP—88-54) Future plans for the MP line (Both general and specific).** Underwood, D.G. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. (CONF-8806203—9). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003972/JAW.

From Symposium on future polarization at Fermilab; Batavia, IL, USA (13 Jun 1988).

This talk consists of three sections. Topics range from suggestions of possible physics, which are presented to provoke thought and discussion about the distant future, to specific goals of E-704 for the next running period. The sections are on physics issues, possible upgrades of the beam and experimental apparatus, and goals for the next running period. 4 refs., 5 figs.

8877 **(BNL—41931) Rf system considerations for a large hadron collider.** Raka, E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 56p. (CONF-8806243—12). NTIS, PC A04/MF A01 - OSTI. Order Number DE89004887/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

In this paper, we shall discuss how we arrive at a particular choice of voltage and frequency; the type of acceleration structure that would be suitable for obtaining the required voltage and resonant impedance; static beam loading including a simplified beam stability criterion involving the beam current and total rf system shunt impedance; the basic principle of rf phase and frequency control loops; and the effect of rf noise and its interaction with these loops. Finally, we shall consider the need for and design of rf systems to damp independently coherent oscillations of individual bunches or groups of bunches. 30 refs., 17 figs., 2 tabs.

8878 **(BNL—41953) A 0.5 to 3.0 MeV monoenergetic positron beam.** Huomo, H.; AsokaKumar, P.; Henderson, S.D.; Phlips, B.F.; Mayer, R.; McDonough, J.; Hacker, H.; McCorkle, S.; Schnitzenbaumer, P.; Greenberg, J.S. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016;AC02-76ER03074. 3p. (CONF-8808122—15). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004531/JAW.

From 8. international conference on positron annihilation; Gent, Belgium (29 Aug 1988).

An adjustable, 0.5--3 MeV monoenergetic positron beam has been constructed at Brookhaven. Currently a $^{22}Na$ source with a W(100) foil transmission moderator produces a 1.1 mm FWHN beam with an intensity of 3{times}$10^5$ $e^+$/sec at a target located downstream from the accelerator. The divergence of the beam is less than 0.1{degree} at 2.2 MeV energy. A SOA gun with 2 lens transport system brings the beam to a focus at the entrance of an electrostatic 3 MeV Dynamitron accelerator. The post acceleration beam transport system comprises 3 focusing solenolds, 4 sets of steering magnets and a 90{degree} double focusing bending magnet. The beam energy spread at the target is $<1$ keV FWHN deduced from the beam size. Below we describe the positron extraction optics and acceleration, the construction of the beamline and the beam diagnostic devices. The salient beam parameters are listed at the end of this paper. 2 refs., 3 figs., 1 tab.

8879 **(BNL—41975) Test results from recent 1.8-m SSC [Superconducting Super Collider] model dipoles.** Wanderer, P.; Cottingham, J.G.; Dahl, P.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Herrera, J.; Kahn, S.; Kelly, E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880812—29). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004529/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

We report results from four 1.8 m-long dipoles built as part of the Superconducting Super Collider (SSC) R&D program. Except for length, these models have the features of the SSC design, which is based on a two-layer cosine theta coil with 4 cm aperture. As compared to the 17 m design length SSC dipoles, these 1.8 m magnets are a faster and more economical way of testing design changes in field shape, conductor support in the coil straight-section and ends, etc. The four magnets reported here all reach fields in excess of 7.5T with little training and have excellent field shape. 10 refs., 2 figs., 3 tabs.

8880 **(BNL—42151) UV photoemission studies of metal photocathodes for particle accelerators.** Fischer, J.; Srinivasan-Rao, T. (Brookhaven National Lab., Upton, NY (USA)). 1 Sep 1988. Contract AC02-76CH00016. 25p. (CONF-8803129—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004559/JAW.

From 4. workshop on laser switched power accelerators; Erice, Italy (4 Mar 1988).

Photoemission from several metals was studied with 10 ps laser pulses at 266 nm. The yield was linear with energy and with area. Quantum efficiencies ({eta}) were determined (up to 10/sup {minus}3/ e/photons for samarium), and found to vary as (hν-{phi})$^2$. {eta} also increased with the field. The field assisted efficiencies were calculated for some metals and confirmed by experiment for gold, up to surface fields of {approximately}3{times}$10^8$ V/m. High charge and current densities, close to $10^5$ A/cm$^2$ from macroscopic areas, were measured or indicated. Results are then related to applications in accelerators. 18 refs., 15 figs., 4 tabs.

8881 **(CONF-8809159—3) Isotopic tellurium targets for heavy-ion nuclear physics produced by vapor deposition.** Greene, J.P.; Thomas, G.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003961/JAW.

From 14. world conference on the International Nuclear Target Development Society; Darmstadt, F.R. Germany (5 Sep 1988).

A variety of $^{122}Te$ targets were prepared by vapor deposition using resistive heating on various substrates. Substrate preparation proved crucial for the production of superior targets. Experimental runs on the Argonne ATLAS Accelerator showed the targets to be of high purity with little contamination. In addition, we have since prepared self-supporting Tellurium using a gold shadowing technique with Teepol as a release agent. 2 refs.

8882 **(CONF-8809159—4) Recent developments in the target facilities at Argonne National Laboratory.** Greene, J.P.; Thomas, G.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003960/JAW.

From 14. world conference on the International Nuclear Target Development Society; Darmstadt, F.R. Germany (5 Sep 1988).

A description is given of recent developments in the target facility at Argonne National Laboratory. Highlights include equipment upgrades which enables us to provide enhanced capabilities for support of the Argonne Heavy-Ion ATLAS Accelerator Project. Also future plans and additional equipment acquisitions will be discussed. 3 refs., 3 tabs.

8883 **(CONF-8810242—1) A high-intensity plasma sputter heavy negative ion source.** Alton, G.D.; Mori, Y.; Takagi, A.; Ueno, A.; Fukumoto, S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003113/JAW.

From Symposium of Northeastern Accelerator Personnel; New Haven, CT, USA (24 Oct 1988).

A high-intensity, pulsed-mode, plasma-sputter heavy negative ion source has been developed; this source holds promise for a number of uses, including tandem electrostatic accelerator/synchrotron injection applications. To date, the source has been used to generate mA intensities from more than 18 sputter probes. A brief description of the source and typical performance data for a number of ion species are given. 13 refs., 6 figs., 2 tabs.

8884 **(DOE/ER/40155—1-Vol.2) [Superferric Super Collider R and D Collaboration]: Final technical report: Volume 2.** Huson, F.R. (Texas Accelerator Center, The Woodlands). Jul 1987. Contract AC02-84ER40155. 128p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89002744/JAW.

The purpose of this document is to define the physical description, the design requirements and the design criteria used for the stress analysis of the Texas Accelerator Center (TAC) 35-meter long, superferric dipole magnet. 21 figs., 5 tabs.

8885 **(GANIL-A—87-03) Beams from solid materials with the two GANIL ECR source.** Bex, L.; Bourgarel, M.P.; Sortais, P.; Attal, P.; Bisch, M.; Leherissier, P.; Pacquet, J.Y.; Bourgoin, Y. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 13p. (CONF-8711107—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756149/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

Some beam developments with solid materials, mainly /sup 48/Ca (with /sup 48/CaO only), Ni and Cu have been scheduled for 1987. Therefore the development of the two GANIL ECR sources (fig. 1) is underway. With ECR1 in operation on the accelerator Ca, CaCl/sub 2/, CaBr/sub 2/, NiCl/sub 2/ and CuCl have been evaporated in an even (T < 750/sup 0/C), also a rod of Ni and a mixture of CaO + Al previously tested with ECR2. With ECR2, operating on a test stand /sup 40/Ca/sup 6+/ (30 eμA), Ta/sup 18+/ (7 eμA), Ni/sup 6+/ (13 eμA) and Mo/sup 9+/ (5 eμA) are obtained with a rod axially introduced. Moreover evaporation of material (Ni and Cu) placed in a small crucible heated by the plasma is experimented.

8886 **(GSI—88-42-Prepr.) Electron cooling rings.** Liesen, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1988. 29p. (CONF-8806290—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755947/JAW.

From Conference on atomic physics of highly-ionized atoms; Cargese, France (1 Jun 1988).

The lecture is divided into three parts: In the first chapter, basic principles of 'accelerator phycis for users' are presented. After that the method of electron cooling of an ion beam is discussed; this naturally leads to the third chapter which deals with cooling electron-ion recombination processes. (orig./HSI).

8887 (INIS-SU—57/A, pp 59-67) **Dimensions of the territory assigned for the complex of accelerator buildings and structures.** Volchek, Yu.A.; Korenevskij, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780042/JAW.

Voprosy atomnoj nauki i tekhniki.; no.1.

In Designing and building. Scientific-technical collection.

Dimensions of the territory for the complex of accelerator buildings must be assigned from the view point of sanitary probing the territory based on the approach to calculation of dimensions of the sanitary-protective zone by the criterion of economy with account of design protection. This approach permits to ensure radiation safety of the personnel and population, to approach the parameter of complex building density to the standard value as well as to ensure the requirement of rational use of the ground at accelerator construction and operation. 8 refs.; 3 figs.; 4 tabs.

8888 (JINR—R-15-87-288, pp 28-33) **Isotope separator and monochromator with energy absorber.** Kalinin, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780047/JAW. (CONF-8604409—).

From 3. seminar of young scientist of JINR in region of experimental physics; Dubna, USSR (1 Apr 1986).

The description of a magnetic analyzer with wide energy dispersion on the basis of two magnetic spectrographs is presented. Energy absorber is located in the focal plane. It is shown that beam purification in the case of Ar fragmentation when shutters are used in the focal plane and when isotopes with A/Z = 3 are passed reaches the value of 10/sup 12/ - 10/sup 13/. The U-400 cyclotron heavy ion beam monochromator permits to monochromatize the primary beam with the energy spread of approximately 1 % up to 4 x 10/sup -4/, and, in its turn, the beam intensity decreases by 4 % of the primary beam intensity. When the distributed thickness energy absorber is used instead of the analyzing slit, the same monochromaticity is attained without intensity loss. The absorber can be produced in the form of a wedge-shaped foil. 11 refs.; 5 figs.; 2 tabs.

8889 (JINR—R-15-87-288, pp 34-39) **Collective accelerator ion beam spectrometer.** Cheremukhin, A.E. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780047/JAW. (CONF-8604409—).

From 3. seminar of young scientist of JINR in region of experimental physics; Dubna, USSR (1 Apr 1986).

For spectrometry of pulsed heavy ion beam with particle density of 10/sup 19/ - 10/sup 21/ cm/sup -2/ x c/sup -1/ of the KUTI-20 collective accelerator a variant of spectrometer, the operation of which is based on the measurement of heat release profile in the layer of a homogeneous substance of target during particle deceleration to their full slowing-down is suggested. The temperature-sensitive element signal amplifier circuit is presented. The spectrometer permits to determine the energy and element composition of the multicomponent beam. It is characterized by insensitivity to ion charge, small weight and size and it can be used for ion beams with the energy up to 20 MeV/nucleon. 9 refs.; 10 figs.

8890 (JINR-D—9-87-105-Vol.1, pp 150-152) **Automation of control of the U-400 cyclotron multicharged ion source.** Kas'yanov, A.A.; Rybin, V.M.; Kutner, V.B. and others. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An arc ion source with a heated cathode and cathode sputtering of the working substance (MCIS) is used at the JINR LYaR U-400 cyclotron to produce multicharged ion beams. To increase the efficiency of studies with multicharged ions, os stable beam production and to ensure the optimum operation modes of the source the necessity of on-line control over its parameters using hardware arose. Control microprocessor subsystem on the basis of CAMAC apparatus was developed, which has become a part of the on-line system for parameter control. The subsystem comprises two CAMAC crates - resident and MCIS control ones - each of them containing the KM001 built-in microcomputer. The resident crate ensures dialogue interaction with an operator and transmits commands to the control crate, it is also used for communication with the SM-4 minicomputer. The software is realized using the ASSEMBLER language and the INTEL 8080 processor. 4 refs.; 2 figs.

8891 (JINR-D—9-87-105-Vol.1, pp 304-305) **Improvement of time structure of beam current during slow extraction from the JINR synchrotron.** Glushchenko, V.G.; Doroshenko, A.Z.; Issinskij, I.B.; Kurskov, I.A.; Sikolenko, V.F.; Smirnov, A.A.; Tishchenko, V.L. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The use of beams slowly extracted from the synchrotron at high intensities in a number of experiments was limited by their deep low-frequency modulation (80-100%) caused by the pulsation of the primary magnetic field. The improvement of uniformity in particle extraction has become possible after improvement of power supply sources of resonance coils, development of the asynchronous circuit to control rectifier transformer of magnet power supply putting into action the active filter compensating magnetic field pulsations in the operation region of accelerator chamber and improvements caused by fast response increase and feedback stability in the current of the extracted beam. Due to the mutual operation of all the systems during slow extraction without high frequency, low-frequency modulation of beam current was reduced to 30-40% which increased the efficient duration of slow extraction by 7-8 times and the set of statistics in one of the experiments increased by 30-50 times. 4 refs.; 5 figs.

8892 (JINR-D—9-87-105-Vol.1, pp 375-378) **Wide-band system for suppression of beam transverse dipole oscillations in the IHEP accelerator.** Ado, Yu.M.; Vershinin, A.I.; Lebedev, O.P.; Polyakov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A wide-band system for suppression of betatron oscillations in the IHEP accelerator is described. The system comprises a detector recording the deviation of the bunch center of gravity, a magnetic pusher operating in the transverse direction, amplifying elements providing for a signal transverse along the channel for the time equal to the bunch time of flight from the detector to the pusher. The maximum damping decrement introduced by the system into bunch betatron oscillations with 1.35 GeV energy makes up {similar←to}10/sup 3/ s/sup -1/, feedback circuit amplification factor is {similar←to}5x10/sup -3/ mrad/mm. With the maximum amplification factor and (0.01-5)mm bunch center of gravity transverse oscillation amplitudes the feedback circuit operates in a linear mode. The presence of a virtual detecor in the system allows one to avoid the decrement dependence on the accelerator betatron frequency. Combined operation of narrow-band and wide-band systems for suppression of coherent betatron oscillations provides for the operation of the IHEP accelerator with 1.2x10/sup 13/ proton beam intensi in the cycle. 8 refs.; 3 figs.

8893 (JINR-D—9-87-105-Vol.1, pp 47-50) **Structure and organization of control system for beam extraction from the IHEP synchrotron.** Dil'mukhamedov, B.B.; Elin, A.P.; Kallistratov, E.N. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An on-line control system for beam extraction (CSE) from the IHEP accelerator is described. The CSE structure has star-like configuration with the central "Elektronika-60" microcomputer and seven peripheral microprocessors. The CSE solves two classes of problems: control problems and procedures of equipment modules (EM). The MO concept is the basis for arrangement of decentralized data processing in CSE. CSE successfully operated during three physical experiments. 5 refs.; 2 figs.

8894 (JINR-D—9-87-105-Vol.1, pp 143-146) **System for axial injection of ions into the U-200 cyclotron.** Vinogradov, Yu.B.; Gikal, B.N.; Gul'bekyan, G.G. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The axial injection system of the JINR U-200 cyclotron is described. Armoured solenoids were chosen as focusing elements of the injection channel external part. Electrostatic inflector was used to bend the beam from the vertical direction to median plane of the cyclotron. The system of axial injection has the acceptance of 1500 mm x mrad. /sup 4/He/sup 1+/ ions are planned to be used as test particles. The calculated efficiency of beam passage from a source to a physical target is approximately 1 %. 7 refs.; 5 figs.

8895 (JINR-D—9-87-105-Vol.1, pp 153-156) **Beams of rare isotopes from internal target of the JINR synchrotron.** Golutvin, I.A.; Dolya, S.N.; Zarubin, A.V.; Sviridov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of the experiment on the extraction of fluorine parent nucleus fragments (/sup 19/F), /sup 12/B, /sup 14/C, /sup 16/N, etc. from the internal target of the JINR synchrotron via the slow extraction channel are presented. The upper boundary of the yield of fragments with fractional charge (Z = 7.7) is evaluated. Characteristics of the fragment momenta distribution are measured. The momentum of /sup 19/F primary nuclei is approximately 4 GeV/c nucl. The study of secondary nuclei, formed in the synchrotron internal target permitted to determine charge composition and intensity of secondary nuclei beams: in C/sup 14/ nuclei extraction mode its partial intensity is 70 %, the yield of C/sup 14/ nuclei into the channel per one /sup 19/F primary nucleus is 3 x 10/sup -5/. Cross section of fluorine nucleus charge-exchange into oxygen is evaluated: $\sigma$(/sup 19/F -> /sup 19/O) $\simeq$ 3 x 10/sup -29/ cm/sup 2/. At the level 3 x 10/sup -31/ cm/sup 2/ no nuclei with fractional charges were found. 7 refs.; 8 figs.; 1 tab.

8896 (JINR-D—9-87-105-Vol.1, pp 403-405) **Beam axial matching in an accelerator with spatial uniform quadrupole focusing.** Balabin, A.I.; Vorob'ev, I.A.; Kapchinskij, I.M.; Kozodaev, A.M.; Kolomiets, A.A.; Shakhraj, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

It is necessary to match the injector beam with the channel, for which matching conditions change periodically with the frequency of the accelerating field, to realize fully possibilities of the accelerating structure with spatial uniform quadrupole focusing (SUQF). The matching initial accelerator part is used at the 3 MeV linear accelerator (LA) with SUQF. Three-electrode electrostatic lense with earthed external electrodes is used to match the injector beam with the accelerator channel. Experimental estiamation of injector beam matching with the accelerator is carried out by measuring the coefficient of beam transport through the accelerator. The coefficient has been determined as the ratio of beam current at the accelerator output to injection current. The maximum value of beam current at the accelerator output obtained, when operating with the given injector, constituted 245 mA at Y/sub inj/=360 mA. This value approaches to the Coulomb limit of LA and is at the same level with maximum currents reached in accelerators with magnetic quadrupole focusing operating at the same wavelength of the accelerating field. 4 refs.; 5 figs.

8897 (JINR-D—9-87-105-Vol.1, pp 84-89) **Organization of a distributed control system on the base of microprocessor modules.** Alekseev, N.N.; Piskunov, V.P.; Ryabtsev, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The problems concerning improvement of present-day on-line control systems designed on the basis of a minicomputer and the traditional structure of CAMAC-VECTOR-type interfaces are discussed. Using the on-line control system of the ITEP U-10 proton synchrotron as an example, one of possible versions of designing a distributed control system for an accelerating complex on the base of microprocessor modules is considered. The feature of the proposed architecture is the equipment simplicity, as well as a possibility of evolutionary improvement of the present-day system. It is proposed to solve the problem of realization of software on the basis of the m/nodal interpreting system used in the U-10 on-line control system for the recent years. 7 refs.; 3 figs.

8898 (JINR-D—9-87-105-Vol.1, pp 92-95) **System for automation of the model superconducting synchrotron.** Bazyleva, N.P.; Efimov, L.G.; Kolpakov, I.F. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An on-line system of the 1.5 GeV "SPIN" superconducting synchrotron is described. At present two subsystems on-line with the MERA-60 microcomputer, which are connected with the CM-4 host computer are operated. Software of all the microcomputers

used in the MERA-60 on-line system functions within the frames of the RAFOS real-time operating system. All programs of the subsystem for control of the synchrotron cycle are written in MACROASSEMBLER language and they occupy 37 kbyte in the operating memory together with the mass memory. The software main part for thermal measurements is written in high-level FORTRAN-4 language. The total body of programs of this subsystem is 15 kbyte. 5 refs.; 2 figs.

8899 (JINR-D—9-87-105-Vol.1, pp 96-99) **Organization of control of the model superconducting synchrotron cycle under regime of thermal testing.** Efimov, L.G.; Man'yakov, P.K.; Parfenov, A.N.; Pasevich, K.; Pilyar, A.V.; Susova, G.M.; Trachik, K.; Shelaev, I.A. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Organization of automated control of the SPIN model superconducting synchrotron cycle is considered under regime of thermal testing. The control subsystem operates on-line with the MERA-60 microcomputer. The subsystem time diagram during the accelerator cycle is given. The control and recording equipment are made in the CAMAC standard. The software is written in MACROASSEMBLER and it functions within the frames of the RAFOS real-time operating system. 6 refs.; 5 figs.

8900 (JINR-D—9-87-105-Vol.1, pp 100-102) **Organization of low-temperature measurements on the SPIN model superconducting synchrotron.** Efimov, L.G.; Kakurina, V.I.; Korolev, V.S. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An on-line system for measuring magnet and helium temperatures on the SPIN superconducting synchrotron, which is under design in the JINR, is described. TVO-type carbon resistors are used as temperature-sensitive elements. To measure signals from transducers a multi-channel system for measuring analogue signals with an intermediate frequency converter is used. The measuring input number is up to 56, measurement accuracy of thermoresistor resistance is not worse than 10/sup -5/. The minimum measurement period is not more than 1 min. 4 refs.; 2 figs.

8901 (JINR-D—9-87-105-Vol.1, pp 103-105) **Digital system for current stabilization in magnetic system coils of isochronous cyclotron electron model.** Glazov, A.A.; Kalmykov, A.V.; Novikov, D.L.; Savaneev, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The system for current stabilization in correction coils of an isochronous cyclotron electron model (EhMITs) is described. The "Elektronika-60" with the CAMAC crate connected to it is used as a host computer. Preset currents are measured by a V7-34A voltmeter. The measurement error is 10/sup -5/. The program package is written in ASSEMBLER. At the present stage the current stabilization system in the EhMITs correction coils is under pilot operation. 5 refs.; 3 figs.

8902 (JINR-D—9-87-105-Vol.1, pp 301-303) **Magnetic system of a cylindrical betatron.** Kas'yanov, V.A.; Romanova, V.A.; Chakhlov, V.L. (Tomskij Politekhnicheskij Inst. (USSR). Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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It is advisable to use a guiding magnetic field of the magnetic mirrors type to accelerate electrons. A design of betatron electromagnet called cylindrical is suggested. In this electromagnet a guiding magnetic field ensuring a stable electron motion during acceleration in the operation gap with a high ratio of the axial size of the operation range to the radial size is formed with the aid of ferromagnetic radial ridge, central inserts and distributed turns of the magnetizing winding. Experiments on electron capture and acceleration are performed using a functional model of a cylindrical betatron. In the case of injection voltage equalling 25 kV the maximum number of particles captured into acceleration is about 1.8x10/sup 12/ with capture coefficient about 10%. Thus, the average particle density in the operation volume of a cylindrical betatron is an order higher than that for known betatrons for the same energy of injected electrons. 5 refs.; 2 figs.

8903 (JINR-D—9-87-105-Vol.1, pp 306-308) **Power supply system of a linear induction accelerator with magnetic compression of current pulses.** Vakhrushin, Yu.P.; Kupriyanov, A.P.; Ehrmel', V.Eh.; Yakovlev, Yu.N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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There is now great interest to magnetic compression systems - magnetic pulse generators (MPG) which permit to form pulses up to TW units . Magnetic generators are used in pulse power systems of linear induction accelerators. Pulse power of 620 MW is obtained with the obtained pulse generator on 1 Ohm active load, 25 kV output voltage, 300 ns pulse duration at the 0.5 level. Time compression coefficient is 31, current coefficient ,25. It is shown that designing high-power MPG allowing formation of current pulses with parameters typical for pulse power systems of linear induction accelerators is due to the development of compression chain design providing low residual induction. Reduction of parasitic inductions of discharge circuits of MPG functional model compression chains is achieved by application of large-size cores for magnetic switches and axial symmetrical arrangement of compression chain elements. 5 refs.; 3 figs.

8904 (JINR-D—9-87-105-Vol.1, pp 309-313) **Series of second generation IST type controllabe stabilized current sources for high-energy accelerating complexes.** Alekseev, B.A.; Zasenko, V.A.; Ivkin, V.G. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The second generation of industrial controllable sourses of the IST 2 series with 0.01% stability stabilized direct current sourses is developed with respect to technical and operation requirements primarily set to the equipment of accelerating complexes of high energies UNK, EhKMF, NR-2000, VEPP. The series included 7 types varying in current and voltage. All the equipment of sourses of the IST 2 series except the transformer and the switch is placed in the assembly of power supply assembly. The electronics and the major part of relay automatics is assembled on printed circuits of the standard size 233.5 x 160 mm. Weight, size and cost indices of the IST 2 series specific for a kilowatt of output power are improved as regards IST series by more than 1.5 times in the average. A prototype model of the IST2-1000-230 series was tested and the tests of the pilot lot are now under way. 3 figs.; 1 tab.

8905 (JINR-D—9-87-105-Vol.1, pp 314-316) **Operation experience of the main power supply system of the IHEP fast-cycling booster.** Anikin, A.L.; Vasin, S.V.; Galushchak, S.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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During the operation of power supply system (SS) for booster electromagnet - a new ring injector of the JHEP proton synchrotron a number of problems were solved which permitted to increase the quality and reliability of SS and booster operation. The change in the basic circuit of the power supply was efficient in the

reliability increase and improvement of SS performances. A new system of stabilization of booster magnetic cycle was put into operation in 1986.The introduction of the 'gate' circuit to limit the time position of igniting pulses is important to increase SS operation reliability. A noticeable increase in the number of failures of SS power supply switches occured after the development of fast response protection. A number of other SS units and components were also changed during operation, such as units of thyristor, switch compensating circuits, the design of thyristor water cooling unit, the diagram of feed rectifier control (VP1-VP4) and others. 3 refs.; 2 figs.

8906 (JINR-D—9-87-105-Vol.1, pp 317-319) **Optimization of the U-70 synchrotron booster magnetic cycle duration.** Goncharenko, V.P.; Gusev, O.A.; Konstantinov, A.I.; Lebedev, A.P.; Rezchikova, N.S.; Fedorov, V.D.; Myaeh, Eh.A.; Pletenev, B.V.; Troyanov, E.F. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The power supply system of the main coils of the U-70 ring electromagnet is a pulse resonance circuit and ensures pulse train passage. To decrease electromagnet voltage to earth the power supply system is separated into two groups connected in series into a 'circle'. Booster pulse mode realization with pulse foot duration ≦40 ms (f/sub n/=25 HZ) in the existing circuits meet difficulties caused by coil commutation from series connection to parallel. The circuit of pulsed power supply of booster electromagnet coils with the application of the minimum amount of additional equipment in the form of additional resistors to discharge the main accumulating capacitor is given. The results of computer simulation are presented. 2 refs.; 2 figs.

8907 (JINR-D—9-87-105-Vol.1, pp 320-322) **Peculiarities of magnetic cycle formation on the BU-70 proton synchrotron during its operation with the booster.** Vasil'ev, S.N.; Gusev, G.I.; Gusev, O.A. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The measures to ensure the formation of a stable field flattop in the magnetic cycle of the BU-70 cyclotron with booster operation are described. To protect thyristor modules (TM) from overloads fast response switches of direct and reverse current of bridge rectifiers, electromagnetic short-circuiting switch with 150 μs operation time are used. To reduce the number of supply system switch-offs the interlocking of short-circuiting switch response to inverter change of state is introduced. A single channel asynchronous system of pulse phase control is put into operation. Measures for further improvement of booster flattop stability are described. 2 refs.

8908 (JINR-D—9-87-105-Vol.1, pp 323-327) **Analysis of transient processes in a power supply system of linear induction accelerators.** Miroshnichenko, A.L.; Orlov, A.K. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The algorithm and the technique of calculating transition processes in the supply system of linear induction accelerators are presented. The equivalent circuit of the LIU-1,25-200 accelarating module and the results of calculating transition processes in the LIU 5/500 modulators and the LIU-1,25-200 accelerating module are given. 9 refs.; 4 figs.

8909 (JINR-D—9-87-105-Vol.1, pp 332-334) **Pulse power supply for magneto-optical elements with current amplitude stability of +-5x10/sup -5/.** Bardik, Yu.I.; Vasilevskij, A.V.; Dil'mukhamedov, B.B. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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A power supply with digital feedback current in extraction and transport systems of beams from accelerators is developed. A software-hardware complex on the basis of microcomputer to feed magneto-optical elements in fast extraction and transport systems is described. Characteristics of measurement-control channel obtained in the course of durable tests of the above supply source are given. The amplitude stability of discharge current +-2 x10/sup -5/ is obtained. 4 refs.

8910 (JINR-D—9-87-105-Vol.1, pp 386-389) **Calculation and measurement of longitudinal coupling impedance of corrugated vacuum chamber of the IHEP proton synchrotron.** Balbekov, V.I.; Gertsev, K.F.; Kopylov, L.I.; Mikheev, M.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The particle self-bunching inside the existing bunches which is accompanied by centimeter range SHF-signal is observed in the IHEP proton synchrotron. Based on the experimental investiation it was ascertained that the central SHF-modulation frequency depends on the particle energy and reduces from 6 GHz at E=7 GeV to 5.7 GHz at E=70 GeV, the spectrum width falls within 100-30 MHz and the reduced impedance increases in the same energy range from 90 Ohm up to 300 Ohm. Calculations have shown that such impedance may occur due to vacuum chamber corrugations. To confirm this, measurements of characteristics of short resonators made of pieces of 4-70 accelerator corrugated chamber, were performed. Methods and measurement and calculation results are presented. 4 refs.; 4 figs.

8911 (JINR-D—9-87-105-Vol.1, pp 51-55) **Peculiarities of designing on-line systems for controlling magnetic field of proton synchrotrons and storage rings.** Kofman, V.M.; Mizintsev, A.V.; Rozhkov, V.N.; Smirnov, A.A.; Snedze, M.G.; Tunkin, A.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Some peculiarities of constructing an on-line system for magnetic field control and a servo-system for electromagnet power supply control of the proton synchrotron and the accelerating-storage complex (UNK) IHEP are considered. Utilization of the power conversion equipment of commercial production and assurance of the required quality of magnetic field control at power supply from the industrial power line without additional stabilization of alternating voltage are shown to be specific features of ASC electromagnet power supply system. The presented control system permits to shape pulses of the magnetic field with different programs of voltage control of the groups of sources. 4 refs.; 2 figs.; 1 tab.

8912 (JINR-D—9-87-105-Vol.1, pp 78-79) **Multichannel function generator using pulse-duration modulation for remote control of magnetooptical elements power supplies.** Dil'mukhamedov, B.B.; Elin, A.P.; Komarov, V.V.; Matyushin, A.A.; Trofimov, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The complex of hardware and software means on the base of microcomputer and standard electronics was produced for effective control of the regime of magnetic optics in transport channels for beam extraction from the IHEP accelerator. Particularly, a reference voltage multichannel generator for power supplies of magnetooptical elements (MOE) using PDM-signal as intermediate input medium has been developed. This solution makes it possible to lower the price of the equipment and to simplify galvanic decoupling of spatially separated power supplies. 2 refs.; 1 fig.

8913 (JINR-D—9-87-105-Vol.1, pp 193-196) **Results of tuning power RF system of the beam rebunching station of the U-70 synchrotron for the UNK accelerating field frequency.** Butryakov, Eh.N.; Gurov, G.G.; Katalev, V.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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In accordance with the program of the Serpukhov proton synchrotron (U-70) preparation to its operation as injector for the UNK the efforts are being made to construct the station of beam rebunching (SBR) from 6 MHz frequency to the UNK accelerating field frequency - 200 MHz. Resonator accelerating system with bridge power supply is used in SBR. Resonators are provided with basic oscillation special control damper. Waveguide feeder with 860x300 mm dimensions is made to transmit RF-power to the accelerating system. Feeder length is 145 m. Results of tuning and testings of SBR RF-system are presented. 100 kW power obtained with RF generator. 500 kW power was constantly fed in resonator. Electric field intensity along the feeder did not exceed 0,2 V/m during 100 kW power transmission along feeder. Investigation results of SBR accelerating system with U-70 beam are presented. It is shown, that SBR does not introduce noticeable disturbances to beam acceleration in the U-70. 7 refs.; 2 figs.

8914 (JINR-D—9-87-105-Vol.1, pp 225-227) **Electrodynamic simulation and numerical optimization of resonators and resonance decelerating systems.** Bukharin, V.L.; Kachinskij, I.Eh.; Sobenin, N.P.; Yanchenko, V.V. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Technique description of electrodynamic simulation and numerical optimization of complex-shaped resonators is presented. Program package for numerical construction of systems of fundamental vector orthonormalized functions in axisymmetric resonators is developed. Calculation relative error for resonance frequences of high-order oscillation modes constitutes (1-5)x10/sup 3/. Calculation of one oscillation mode takes 20-100 s using the EC-1060 computer. The developed technique and programs allow to study electrodynamic characteristics of generator-accelerating systems, to take into account beams effect on systems resonant frquencies, to determine coefficient of energy transmittion from generator beam to accelerating one, and to conduct systems optimization by structures geometry and parameters of generator and accelerating beams. 10 refs.

8915 (JINR-D—9-87-105-Vol.1, pp 228-231) **To the solution of three-dimensional problem of electrodynamics of azimuthal-non-symmetric accelerating structures with internal coupling cells.** Miroshnichenko, A.L.; Orlov, A.K. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Description of algorithm for solution of three-dimensional electrodynamics problem for azimuthal-nonsymmetric accelerating structures with internal coupling cells is presented. Particular case of biperiodic systems with internal coupling cells are considered, and more briefly - toroidal cells, as well as cells close to omega-shaped ones. Electromagnetic coupling between resonators is carried out by azimuthal slits. 9 refs.; 2 figs.

8916 (JINR-D—9-87-105-Vol.1, pp 239-242) **To the calculation of the H-wave structure with end region.** Abramov, A.G.; Barsukov, A.B.; Belyaev, O.K. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Low-energy ion linear accelerator H-resonator parameters were investigated theoretically and experimentally. Using modification of partial region method, where finite element method is used for determination of normal waves, in every subregion the solution of three-diminsional problem is being constructed. Dependences of frequency, proper Q-factor and relative losses at flanges for operating oscillation on front region length were measured. For structures with spatial-uniform quadropole RF-focusing the technique allows to remove restrictions for cross section configuration and to take into account the front region - basic element within the structure with longitudinal magnetic field. 10 refs.; 3 figs.

8917 (JINR-D—9-87-105-Vol.1, pp 298-300) **Quadrupole lens for a racetrack microtron.** Savitskij, A.B.; Sotnikov, M.A.; Shvedunov, V.I. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The results of optimization of dimensions and shape of quadrupole lens pole for the 100 MeV 100 μA continuous-action racetrack microtron with 25 orbits are presented. An experimental model of a small-width quadrupole lens was made on the basis of calculations performed. The lens is made of four pole pieces connected by pins and lateral plates fastening the lens. Lens yoke is made of ARMCO iron, the coils are winded by 0.5 mm wire (75 windings in each coil). Lens length is 10 cm. The nature of changes in magnetic field components at the lens edge and the dependence of magnetic field gradient on coil current is studied. When current changes from 0.7 to 2 A field gradient increases linearly and no saturation takes place. This permits to use the quadrupole lens for a particle beam at all the orbits of the racetrack microtron. 7 refs.; 3 figs.

8918 (JINR-D—9-87-105-Vol.1, pp 328-331) **Energy and time parameters of inductive-transformer circuits for pulse power supplies o electromagnets of cyclic accelerators.** Otrubyannikov, Yu.A.; Safronov, A.S. (Tomskij Politekhnicheskij Inst. (USSR). Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Induction-transformer circuits of pulse power supplies of electromagnets of cyclic accelerators which permit to isolate power circuits from the power supply and to provide quasitriangular operation mode and thus reduce the mass of the device are developed. Operation modes of commutation circuit of the 'electromagnet parallel' and in the 'recuperation circuit' type are analyzed. Calculations show that quasitriangular mode is the mast efficient from the viewpoint of decreasing commutation time, eddy losses and voltage in the oscillatory circuit. 7 refs.; 4 figs.

8919 (JINR-D—9-87-105-Vol.1, pp 164-168) **High-effective accelerating structure of a heavy-ion linear accelerator.** Bomko, V.A.; D'yachenko, A.F.; Kobets, A.F.; Pipa, A.V.; Rudyak, B.I.; Khizhnyak, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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The description, main parameters and several variants of tuning systems of post-stripping section of heavy ion linear accelerator are presented. The accelerating system ensures ion acceleration $A/g \leqq 5$ up to the energy of 8.5 MeV/nucleon. It comprises several types of tuning systems and is located in one section 11.4 m long with the resonator diameter of 1.5 m. The tests conducted in the mode of ion acceleration confirmed its high parameters. 4 refs.; 3 figs.; 1 tab.

8920 (JINR-D—9-87-105-Vol.1, pp 246-249) **Drift tube accelerating resonator tuning.** Bylinskij, Yu.V.; Esin, S.K.; Zharinov, I.S.; Ostroumov, P.N.; Paramonov, V.V.; Feshchenko, A.V.; Sharamentov, S.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Accelerating system of initial part of Nuclear Research Institute meson factory linear accelerator consists of 5 drift tube resonators. Tuning of an accelerating system began from the 5th resonator and included setting to required frequency, the field distribution flattening and matching with fider. In initial part resonators three tuning element types are allowed. Stationary elements represent rectangular ducts 200x700 mm in size. Their height may vary from 20 to 70 mm and is determined in tuning. Hand-operated and combined elements represent cylindrical pistons 200 mm in diameter submerge depth of which is varied within 0-160 mm. The field distribution was measured by method of perturbing body using on-line measurement complex. The field distribution measurement errors are considered. Random errors depend on the size of perturbing body, stability of resonator frequency and its measurement accuracy. Random error was derived by results of 20 field distribution measurements, and perturbing body being 16 mm in diameter, its meansquare value was 0.2%. Systematic errors occur due to irregularity of field distribution in the gap, field redistribution in resonator during introduction of perturbing body in the gap, and due to the effect of measured coupling loop. 2 refs.; 4 figs.

8921 (JINR-D—9-87-105-Vol.1, pp 254-256) **Powerful klystron selfoscillator with external synchronization.** Beloglazov, V.I.; Zavada, L.M.; Kushnir, V.A.; Sdobnova, L.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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For experiments where high stability of electron bunch repetition frequency is required the self-oscillator circuit can't provide for the needed parameters. The present paper is concerned with experimental study on self-oscillator SHF supply system for linear resonance electron accelerators with its synchronization by external low-power SHF generator, that permits to increase stability of oscillation frequency. A 10-cm range powerful klystron pulse amplifier is investigated. Measurements of oscillation frequency with different values of synchronizing oscillator frequency were carried out in course of experiment. Analysis of obtained experimental results shows that use of synchronized powerful klystron self-oscillator permits to improve frequency characteristics of the accelerator SHF-supply system and makes it possible to carry out a series of in-beam experiments requiring high stability of the bunch repetition frequency or its change according to a definite law within the synchronization band limits. 2 refs.; 3 figs.

8922 (JINR-D—9-87-105-Vol.1, pp 268-269) **Calculation of H-wave accelerating structures using qusistatical approximation.** Barsukov, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

H-wave accelerating structures are used in linear resonance ion accelerators with the accelerating field focusing. H-structures formed by a beam of cylindrical canonical waveguides connected by a narror longitudinal irregular slit and short-circuited at the ends by short cylindrical edge regions are considered. H-waves in such structures have localized in a slit (the accelerating channel region) electric component and magnetic component distributed along the waveguide section. When the slit is narrow the field near the channel is described by a scalar potential function (quasistatic approximation), and in partial regions (waveguides) - by one proper function. E-wave contribution is neglected. Using potential function the channel length static parameters - partial capacitances and inductions are determined in the slit. The suggested quasistatic approximation for H-structures permits an easy estimation of the lower spectral part and to investigate the effect of parameters on longitudinal distibution of field. 8 refs.; 2 figs.; 1 tab.

8923 (JINR-D—9-87-105-Vol.1, pp 287-289) **Development and study on pulse frequency capacitors with high specific characteristics.** Goncharenko, V.P.; Gusev, O.A.; Lebedev, A.P.; Slivkov, Yu.K.; Fedorov, V.D.; Kuchinskij, G.S.; Tselishcheva, V.I.; Shilin, O.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR); Leningradskij Politekhnicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Results of development and tests of 1 μPHI, 40 kV capacitors (IK 40-1 type), aimed at pulsed-periodic operation with 2 Hz repetition frequency in power supply systems of large accelerators, lasers, thermonuclear devices, etc. are presented. Use of new dielectric materials is shown to permit 30-40 J/kg specific energy at oscillating discharge and 120 J/kg - at partial discharge. A test scheme permitting to realize different operation conditions of capacitor is given. 1 ref.; 2 figs.

8924 (JINR-D—9-87-105-Vol.1, pp 290-293) **Systems for efficient cooling high-voltage thyristor modules.** Goncharenko, V.P.; Divavin, V.A.; Malyshev, I.F.; Karagezov, Eh.I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR); Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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In developing power supplies for electrophysical installations power thyristor and diode modules are used. Design principles for water and vapor cooling of powerful converters are considered. High-current thyristor and diode modules are made on the base of table type semiconductor devices, connected in series from 5 to 20 pieces in one module. Their cooling is usually carried out in a closed water loop, therewith, water radiators are arranged between semiconductor devices. Analysis of measurement results showes that in designing high-voltage semiconductor modules with nominal current load using OM-104 type radiators connected in series in water, not more than 10 devices may be connected in series, the water flow rate being 8 l/min. Optimization of individual element of copper coolant with a circled heat-removing rib submerged in freon F-113 volume is carried out. It results in determination of minimally possible dimensions of individual. 4 refs.; 1 fig.; 2 tabs.

8925 (JINR-D—9-87-105-Vol.1, pp 294-295) **High-current semiconductor switches of pulse power supply systems.** Goncharenko, V.P.; Gusev, S.A.; Fedorov, V.D.; Lebedev, A.P.; Slivkov, Yu.K.; Grekhov, I.V.; Korotkov, S.V.; Yakovchuk, N.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR); AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The present large accelerators, thermonuclear devices are facilities which operation is directly connected with long-term (frequencies from several to hundreds Hz), fast commutation of powerful DC electric power - from megawatt to terawatt, the voltage being up to several tens kV and currents - up to several hundreds kA. Reversible-switch dinistors (RSD) have the best commutation characteristics in the microsecond range. Tests of prototype RSD-systems on silicon washers 56 mm and 80 mm in diameter in monopulse and frequency modes are carried out. Thus, under monopulse mode, trapezoidal current pulse 100 μs in length and with amplitude of 300 kA was conducted through one device 80 mm in diameter. The current variation rate is about 30 kA/μs. At all frequencies no device failure due to excess of current change rate was noticed. 2 refs.

8926 (JINR-D—9-87-105-Vol.1, pp 296-297) **DC source of enchanced accuracy.** Doroshenko, V.N.; Sinenko, V.G.; Tunkin, A.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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At present stability of DC sources for supply of different electromagnetic elements of accelerating facilities must be qualified under more stringent requirements. A 10 A DC source with relative instability of 2x10/sup -7/ per hour is described. In DC source measuring instruments on the base of SQUID devices are used. 3 refs.; 1 fig.

8927 (JINR-D—9-87-105-Vol.1, pp 419-420) **Electrodynamical characteristics of nonresonance elements of a synchrotron vacuum chamber.** Bogdanovich, B.Yu.; Kaminskij, V.I.; Putkin, Yu.M. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Increase of accelerated beam intensity leads to increase of the effect on particle dynamics of stray fields excited by heterogeneities of the accelerator vacuum chamber. Resonance nonuniformities - elements of the accelerator chamber possessing the proper resonance frequencies of oscillations generated by accelerated particle bunches, make main contribution to the development of beam instability. Investigations are carried out using E-type waves responsible for the longitudinal beam stability by the low perturbation method. The investigations are carried out using conical and step-wise transitions between two cylindrical ion-guides of 69 mm and 98 mm diameters. The length of conical transitions varied from 0 to 150 mm. Measurements of field distribution are carried out in the frequency range from 2.3 to 4.5 GHz. The results of measurements carried out for reflection factors of transitions in the wide range of frequencies and coupling resistance can be used to estimate losses of accelerated beam energy in these elements of the vacuum chamber. 2 refs.; 3 figs.

8928 (JINR-D—9-87-105-Vol.1, pp 461-464) **Calculation and design of precise 180 deg magnets for a racetrack microtron.** Grishin, V.K.; Sotnikov, M.A.; Shvedunov, V.I.; Dajkovskij, A.G.; Ershov, S.Yu.; Babayan, A.Z.; Tumanyan, A.R. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of calculation of 180 deg beam bending magnet (BBM) for a continuous racetrack microtron are presented. The field values constitute approximately 0.76 T. The magnet mass is 18000 kg, the pole piece mass - 1200 kg, copper mass - 400 kg. The pole pieces and distance pieces are separately assembled and fixed in a magnet yoke by two lateral stainless cheeks. The pole winding consists of 7 wafers. The winding assembly is simple and excludes complex machining attachments. 9 refs.; 5 figs.; 2 tabs.

8929 (JINR-D—9-87-105-Vol.1, pp 277-280) **Study on the cm-range pulse gyrocon functional model.** Balakin, V.E.; Brezhnev, O.N.; Zakhvatkin, M.N. and others. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

For excitation of VLEPP accelerating structure the cm-range multiresonator pulse gyrotron functional model is designed and produced. Accelerator ELIT-L2 is a REB source for the model. In experiments 50 MW power measured by calorimeter was produced. The efficiency is 20% and is limited by break-downs of the output resonator. The measured frequency range is 3-4 MHz. 3 refs.; 3 figs.

8930 (JINR-D—9-87-105-Vol.1, pp 80-83) **Beam monitors in transport channels of the IHEP accelerator new injection system.** Bruk, V.L.; Demikhovskij, D.A.; Mitrofanov, S.M. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A beam monitoring system for a transport channel of a new U-70 injector consisting of a linac and a booster is described. 20-electrode full absorption transducers are used for measuring emittance and spectrum in the input channel (proton energy - 30 MeV) and secondary-emission beam profile transducers - in the output channel (proton energy - 1.5 GeV). For absolute measurements Faraday cups with a cut-off grid are used. Routine measurements of beam intensity and position are carried out using electrostatic pickup-electrodes. Movable slits are used for measuring beam emittance. To measure the output beam spectrum, magnets, a copper slit and a spectrum transducer are used. The output beam emittance is determined by profile monitors. The main part of processing hardware is designed on the base of a gating charge-to-time converter. The equipment using loss monitors, being a scintillator on the base of polystyrene and photomultiplier is developed. 3 refs.; 5 figs.

8931 (JINR-D—9-87-105-Vol.1, pp 56-60) **JINR phasotron beam monitors.** Denisov, Yu.N.; Dmitrievskij, V.P.; Kalinichenko, V.V.; Mironov, S.V.; Onishchenko, L.M.; Saenko, V.A.; Chesnov, A.F.; Shabashov, M.F. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

JINR phasotron beam monitoring system permitting to realize continuous control of 680 MeV, 10 μA, accelerated proton beam parameters is described. A scintillation NaI γ-detector is the

main element of the monitor for determination of the radius losses. The detector is placed at the distance of 10 m from the chamber. Radial position of the beam is defined by means of a gauge. Five pairs of magnetoinduction sensors are installed in the radius range from 107 to 262 cm with an equal step. Secondary-emission detectors of two types: multielectrode and differential are used. The monitoring system utilizes computerized means of the on-line control system of the phasotron. 3 refs.; 10 figs.

8932 (JINR-D—9-87-105-Vol.1, pp 61-64) **On-line control of extracted beam of a cyclotron.** Komissarov, P.Yu.; Mikhajlov, V.G.; Rezvov, V.A.; Sklyarenko, V.I.; Yudin, L.I.; Bejshovets, V.; Chigak, M.; Shtursa, Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Monitoring stations of on-line control of extracted beams with computerized data processing are developed and operate based on the beam profile monitor in the cyclotrons of the Institute of Atomic Energy (IAE) after Kurchatov and the Institute of Nuclear Physics (INP), Czechoslovakia. With account for real technical opportunities the INP monitoring station is constructed on the base of the M-6000 computer, the IAE monitoring station- on the base of the K-580 microprocessor. Operating experience of the described equipment exhibited reliability of the ionization beam profile monitor, its high sensitivity and good spatial resolution. At the aperture of the monitor up to 90 mm specified by sizes of microchannel plates the threshold sensitivity with an electron multiplier on one of the plates makes up 10/sup -8/ A and 10/sup -10/ A on the chevron of the two plates. Spatial resolution of the monitoring complex equals 1 mm. 3 refs.; 4 figs.

8933 (JINR-D—9-87-105-Vol.1, pp 65-67) **Automation system for protection of an accelerator shield from damage by charged particle beam.** Kapyrin, Yu.V.; Petrenko, V.V.; Trubaev, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Investigations into beam transport system protection by using acoustic signals arising in elements of the system structure at thermoelastic interaction of accelerated charged particles with metal are conducted. An automated system for accelerator protection from its damage by an electron beam is developed based on the conducted studies. The totality of piezoelectric transducers installed over the whole system of beam transport is successively polling by means of the commutator. The automated accelerator protection system has 10 commutation channels and polls them during 1 s. Frequency of channel polling is equal to 0.1 Hz. 3 refs.; 1 fig.

8934 (JINR-D—9-87-105-Vol.1, pp 68-70) **On-line measurement and control system of major parameters of the synchrotron injection complex.** Beznogikh, Yu.D.; Vasilishin, B.V.; Voevodin, M.A. and others. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An on-line measurement and control system of the JINR synchrotron injection complex realized on the base of the SM-3 computer is described. Measurement of beam current pulse shape and amplitude is provided by means of transparent magnetoinduction detectors. A multielectrode sectional target is used for determination of pulse height distributions of particle axial oscillations. A collector representing a frame with uniformly tightened 2 mm step tungsten wires is used for measurement of the injected beam profile. Time characteristics are measured by means of two four-channel binary counters. 6 refs.; 3 figs.

8935 (JINR-D—9-87-105-Vol.1, pp 71-72) **Peripheral optoelectronic system for remote control of the SPIN injector.** Romanov, Yu.I. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The remote control system (RCS) on the base of fiber-optical communication lines (FOCL) of the SPIN facility injector is described. The RCS is disposed in two CAMAC crates. One of them is installed on the control desk, the other one- on the high-voltage terminal. Communication between the crates is realized by eight 10 m parallel transmission FOCL channels used for digital and analog data transmission. 5 refs.; 1 fig.

8936 (JINR-D—9-87-105-Vol.1, pp 73-74) **Multiprocessor system for controlling and measuring parameters of the KUTI-20 accelerator.** Dubovik, L.V.; Inkin, V.D.; Saenko, T.P. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A multiprocessor system for parameter control and measurement of the KUTI-20 heavy ion collective accelerator is described. The system exercises data acquisition, processing and representation in the KUTI-20 parameters. The SM-4 computer takes the higher layer. CAMAC measuring modules and "Elektronika-60" microcomputer take the lower layer. The parameter control and measurement system comprises three measuring modules for KUTI-20, SILUND-20, "Adgezator-20", LUEhK-20 facility parameter control and measurement. Measurement of the parameter is carried out by means of the 128-channel analog commutator and 12-digit analog-to-digital converter. 6 refs.; 4 figs.

8937 (JINR-D—9-87-105-Vol.1, pp 75-77) **Collective monitors for high-current pulse electron beam diagnostics.** Zhabitskij, V.M.; Ivanov, I.N.; Kaminskaya, A.M.; Mel'nikov, V.A.; Stepanov, A.D. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A collector monitor for high-current pulsed electron beams at average power of 100 W and pulse current of 100 A has been developed. The monitor comprises a Faraday cup, profile monitor, sector diaphragm, energy detector. The collector was fixed on a brass radiator transformed into a rod. The rod ensures reliable and electric contact of the collector with the "earth" and small RC of this line. Such design permits to stabilize the heat mode of the collector without utilization of external cooling. The monitors have been tested in electron beams at head load up to 100 W during 40 hours. Wear at the expense of evaporation, microexplosions were not observed. Accuracy of current measuring made up 5-10% for absolute and 1-2% for relative measurements. 12 refs.; 3 figs.

8938 (JINR-D—9-87-105-Vol.1, pp 197-200) **Beam loading compensation in a linear accelerator-the injector of the JHEP proton synchrotron booster.** Mazurov, E.V.; Mal'tsev, I.G.; Masaev, A.B.; Nagaev, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Quadrupole RF-focusing linear accelerator with H-wave accelerating structure is the injector of IHEP proton synchrotron booster. Debuncher on the base of double-gap coaxial resonator, is placed at the accelerator output for accelerated particles energy monochromatization. For quick compensation of RF-field disturbance by beam there are used: in accelerator initial part - nonlinear stabilization system (NSS), in each section of accelerator final part - autocompensation system (AC). Systems fast response constitutes 0,2-0,6 μc. Possibility of NSS usage in combination with method of parameters and regime matching (PRM) in RF-supply circuit is

provided to increase stabilization coefficient. To-day AC system provides beam acceleration with current up to 100 mA with RF-field residual disturbances: by amplitude - 4-6% and by phase - 3-4 deg. Application of PRM method allowed at 100 mA beam current to decrease phase RF-field instability in debunching from 3,8 deg to 1,4 and to obtain on the output the energy spectrum, meeting booster requirements (+-0,3%). Here, RF-field amplitude instability decreases from 7,0% to 3,2%. 5 refs.; 3 figs.

8939 (JINR-D—9-87-105-Vol.1, pp 235-238) **Acoustic action of SHF pulse field in accelerator electrodynamic structures and control of charged particle beam acceleration mode.** Kapyrin, Yu.V.; Moiseev, V.I.; Petrenko, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Evaluation and control technique of beam acceleration mode which lies in measurement of beam take-off power during acceleration, is developed and introduced at the Fakel electron linear accelerator. The control principle is based on the ponderomotive action of pulse accelerating SHF-field in multisectional accelerator elements and lies in measurement of intensity ultrasonic oscillations induced in these elements, which is inversely proportional to power taken off by the beam. Besides tuning and control of acceleration optimal mode this method allows to evaluate and control the quality of accelerating waveguide elements. The system used at the Fakel accelerator realizing this method has two important advantages: for one thing, its usage does not break accelerator operation heavy-current mode, as monitor system is placed outside the accelerating waveguide elements, and for another, the system is noise-free due to different propagation velocity of electromagnetic and acoustic waves, that is very important under the conditions of powerful pulse SHF-facility. 4 refs.; 3 figs.

8940 (JINR-D—9-87-105-Vol.1, pp 147-149) **Beam scanning onto external target.** Arzumanov, A.A.; Batishchev, V.N.; Voronin, A.M.; Gerasimov, V.I.; Gor'kovets, M.S.; Semin, A.S. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Conditions required for the realization of the possibilities to produce irradiation field using accelerated ion beam scanning over the target studied using controlled magnetic field are determined.For the irradiation of targets with geometric dimensions 70 x 100 mm two crest-type electromagnets with additional modulation coils, ensuring changes in +- 300 Gs magnetic field induction in mutually perpendicular planes with the change in supply current +- 3 A in them were used. Block-diagram of the device ensuring uniform irradiation of targets with larger dimensions is given. A digital saw-tooth voltage generator operating in the range of frequencies 3-10 Hz was used as a master generator. 3 refs.; 3 figs.

8941 (JINR-D—9-87-105-Vol.1, pp 157-159) **Physical model of carbon target destruction in ion beams.** Koptelov, Eh.A.; Lebedev, S.G.; Panchenko, V.N. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Physical model of carbon foil destruction in ion beams is suggested. Experimental and calculated data on the basis of the model are compared and the possibility to use the data obtained in the present work for the prediction of lifetime of charge-exchange graphite films in ion beams is discussed. 19 refs.; 1 tab.

8942 (JINR-D—9-87-105-Vol.1, pp 281-283) **Development of automation system for resonator proper frequency control in transition and main regimes of operation.** Kovalishin, A.S.; Poltorakov, A.V.; Kiselev, I.V.; Yamshchikov, G.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Automation system for resonator frequency and temperature change control (AFTC) is aimed at stabilization of resonator proper frequency in all regimes of operation: preparation, transition (HF-power is put into operation) and main (rating). Possibility of developing combined AFTC system to increase accuracy and fast response of production of disturbancies caused by input of HF-power with thermal mode of tuning its proper frequency is investigated. It is shown that use in AFTC system of an extra disturbancy amplification channel permits to reduce considerably time of transition process and to facilitate operation of HF-channel due to improvement of matching between the waveguide channel and resonator, when HF-power input, and to stabilize the resonator frequency of both in transition and main regimes of operation. 4 refs.; 4 figs.

8943 (JINR-D—9-87-105-Vol.1, pp 406-408) **Photochronography of electron-ion ring of the KUTI-20 accelerator by the Agat-SF chamber.** Tyutyunnikov, S.I.; Shalyapin, V.N.; Shcheulin, A.S. 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The first experiments in compression of electron rings in the KUTI-20 adhesator chamber showed that axial size A/sub z/ (half-size at half-height of intensity) exceeded considerably the calculational value A/sub z/=2 mm and constituted A/sub z/=4-8 mm. In this case the growth of the size, being proportional to the electron number in the ring, is observed; and distribution of electron density in cross section differs essentially from Gaussian. To clear up the causes of these phenomena, certain experiments on measuring the sizes of ring cross section in synchrotron light using LI-614 and LI-605-3 dissectors and photochronograph "Agat-SF" in the range of time resolution 10/sup -5/-10/sup -11/ c are carried out. Using operating adjustment of the accelerator for measurement of electron ring axial size, it becomes possible to decrease the size from 8 mm to 3 mm. 4 refs.; 8 figs.

8944 (JINR-D—9-87-105-Vol.1, pp 452-455) **Effect of charged particle accelerated beam proper field on the resolution of a secondary-electron monitor of phase spectrum.** Vorontsov, V.A.; Tron', A.M. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

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Disturbing effect of U-100, LUMPh IYaI and UNK accelerated proton beam proper field on the resolution of three main type phase spectrum monitors (PSM) : longitudinal PSM, where secondary low-energy electrons with emission energy below 50 eV are analysed in longitudinal HF-stopper, and lateral PSM, where delta- or low-energy electrons are analysed by means of the beam lateral HF-stopper, is considered. For analysis of U-100 and LUMPh IYaI beams longitudinal phase spectrum monitors are more preferable. To analyse UNK beam lateral PSM with delta-electron energy exceeding 8 keV are advantageous. 1 ref.; 5 figs.

8945 (JINR-D—9-87-105-Vol.2, pp 14-26) **Electron cyclotron resonance (E.C.R.) ion sources for heavy ion accelerators.** Jongen, Y. (Louvain Univ. (Belgium)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

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Present status of the electron cyclotron resonance ion sources for heavy ion accelerators in the world is given. A brief survey of some typical sources is presented. 21 refs.; 16 figs.

8946 (JINR-D—9-87-105-Vol.2, pp 27-38) **LBL 88-inch cyclotron operating with an ECR source.** Clark, D.J. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The new ECR source and injection system have greatly expanded the range of particles and energies available from the LBL 88-Inch Cyclotron. The external beam intensities are adequate for expewrimental needs, ranging from 100 nA for 27 MeV/u oxygen to 5-10 μA for 6 MeV/u oxygen and neon. The lifetime of the source is days or weeks compared to hours for the PIG source, resulting in increased beam on target time and reduced manpower required for maintenance. Future possible improvements include the installation of higher frequency rf power for the ECR source 2nd stage to increase the high charge state output. 6 refs.; 13 figs.; 3 tabs.

8947 (JINR-D—9-87-105-Vol.2, pp 43-50) **Recent developments in EBIS design.** Schmieder, R.W. (Sandia National Labs., Livermore, CA (USA)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The general designs and status of electron beam ion sources (EBIS) in Sandia National Laboratories in Livermore, the Lawrence National Laboratory, Kansas state University and Cornell University are reviewed. the main parameters of EBIS with superconducting magnet are given. 5 refs.; 8 figs.

8948 (JINR-D—9-87-105-Vol.2, pp 3-13) **Heated-cathode multicharged ion source.** Makov, B.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Conditions of multicharged ion (MCI) formation in the heated-cathode source (HCS) are analysed. Ionization by an electron impact, influence of cathode material sputtering and charge-exchange, working medium supply to HCS are considered. Data on solid multicharged ion yield from the HCS are given. HCS operation with the stationary electric field in the discharge column is considered. Tendencies of HCS development are shown. 49 refs.; 13 figs.; 1 tab.

8949 (JINR-D—9-87-105-Vol.2, pp 39-42) **Two-stage plasma-beam multicharged ion source.** Pavlov, S.N.; Khmaruk, V.G. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Investigation results of applicability of the two-stage plasma-beam system as the multicharged ion source (MCIS) are described. An experimental facility included a cylindrical discharge chamber of 1.2 cm in diameter and 24 cm length, where leak-in of working gas-argon (the 1st stage) was carried out. The electron beam with about 2 keV energy and 1 A current is continuously injected through the discharge chamber to the additional volume of lower pressure (the 2nd stage) of 200 cm length and 15 cm in diameter. Investigations have shown that the best features of ECR sources can be investigated with the two-stage beam-plasma system. Application of two stages permits to produce effective plasma electron heating. Multicharged ion confinement using an electrostatic well can be realized in the system investigated. The ways of the increase of n/sub e/tau/sub i/ confinement parameter (where n/sub e/ is the electron density, tau/sub i/ is the ion life-time in the ionization space) are determined. It permits to consider the two-stage beam-plasma system as alternative with respect to HIS ECR. 8 refs.; 3 figs.

8950 (JINR-D—9-87-105-Vol.2, pp 51-54) **IMI-1 electron-beam multicharged ion source.** Abdul'manov, V.G.; Auslender, V.L.; Kolokol'nikov, Yu.M.; Meshkov, I.N.; Potapov, V.G.; Tutin, G.A.; Ehjsmont, V.P. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The electron-beam ion source is described. The results of multicharged ion production in the ion electron-beam source designed for the B-5 synchrotron are presented. The B-5 synchrotron is designed for acceleration of fully ionized atoms with Z/A=0.5 up to 50 MeV/nucl. energy (value Z is limited by vacuum conditions and does not exceed 20). Experiments are carried out both with the optical system and in ionization mode. N/sup 7+/ nuclei are produced in the number of more than 10/sup 7/ nucl/puls. Al and Ti multicharged ions are produced. 14 refs.; 2 figs.

8951 (JINR-D—9-87-105-Vol.2, pp 55-57) **IYaI AN SSSR pulse polarized protons source.** Belov, A.S.; Esin, S.K.; Kubalov, S.A.; Kuzik, V.E.; Yakushev, V.P. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A pulse polarized proton source operating in the atomic beam mode for a linear accelerator of a meson factory has been developed. The atomic beam is transmitted through two sextupolar magnets and an RF unit in a weak filed. A new type ionizer, where polarized protons, are produced in polarized atoms charge-exchange on deuterium plasma ions and due to atom ionization by plasma electrons, is used in the source. The polarized proton beam with pulse current 10 mA at current density 420 mA/cm/sup 2/ and ion energy 26 keV is obtained. H/sup +/ beam polarization equals 0.76+-0.02. Emittance in the horizontal direction equals 0.16 π cmxmrad, and in the vertical direction - 0.22 π cmxmrad. 7 refs.; 1 fig.; 1 tab.

8952 (JINR-D—9-87-105-Vol.2, pp 58-60) **High-intense laser source of polarized protons and H/sup -/ions.** Zelenskij, A.N.; Kokhanovskij, S.A.; Lobashev, V.M.; Polushkin, V.G.; Vishnevskij, K.N. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The latest results of works on creation of the polarized proton and H/sup -/ ion source with optical pumpimg are presented. As a result of improvement of the proton source, the shaping system, the ionizer, and the laser system, polarized proton beam intensity is increased up to 4 mA with maximum polarization P=65+-3% (6 mA - P= 40%). H/sup -/ ion record intensity - 250 μA at charge-exchange on xenon is obtained. 11 refs.; 3 figs.

8953 (JINR-D—9-87-105-Vol.2, pp 61-64) **Duoplasmatron as a low charged heavy ion source for a linear accelerator iinjector.** Batalin, V.A.; Volkov, Yu.N.; Kondrat'ev, B.K.; Turchin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The heavy ion injector of the ITEP linear accelerator (LA) designed for investigations on the fusion program represents a direct-voltage accelerator. It consists of a vacuum chamber, where an accelerating tube designed for 200 kV voltage, the heavy ion source (HIS) with the beam shaping system and a ion guide with beam monitors, which connects the injector with the input of the

matching LA channel, are mounted. Today a ion-optical system with a locking grid is installed at the HIS. Using it, the next works such as optimization of HIS mode to prduce the maximum output of two-charged ions; measurements of the beam spectra by the specific charge; beam current pulse shaping for injection in LA - are carried out. The optimal conditions for HIS operation are determined and established on the basis of the measurements results. Xenon two-charged ion current in HIS reaches 40 mA with brightness of the beam central part being higher than 10/sup 8/ A/m/sup 2/xrad/sup 2/. 3 refs.; 2 figs.; 1 tab.

8954 (JINR-D—9-87-105-Vol.2, pp 65-67) **Application of composite cathodes for production of multicharged ions of solids.** Dem'yanov, A.V.; Kulish, A.N.; Linev, A.F.; Papash, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Test results on sintered composite cathode of ion sources designed for multicharged ion production are presented. Tests of cathodes are carried out at the JINR U-300 cyclotron and at the U-240 cyclotron of the Nuclear Research Institute of the Academy of Sciences of the USSR. Characteristics of ion source operating conditions and aluminium and boron ion currents from composite cathode assemblies are given. The tests have shown high operating qualities of tungsten cathodes and anticathodes with Al/sub 2/O/sub 3/ additions in case, when relative density is not less than 97% and good aluminium ion yield with Al/sub 2/O/sub 3/ content - in quantity from 10 to 20 vol.%. Such cathode assemblies can be used to produce ions of solids from the usual gas source without a special sputtering electrode or a crucible with a furnace. 8 refs.; 1 fig.; 2 tabs.

8955 (JINR-D—9-87-105-Vol.2, pp 68-70) **Electron source.** Murav'ev, G.V.; Ovchinnikov, V.P.; Tsepakin, S.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The diode type electron source is designed on the basis of lanthanum hexaboride emitter with a contact pyrolytic graphite anisotropic heater. The first electrode of an accelerating tube serves as the anode of the electron source when using in a high-voltage accelerator. The electron source is designed for the electron beam current under the constant mode up to 100 mA. And emission current density is 0.4-0.6 A/cm/sup 2/. Intense heat power does not exceed 50 W at intense filament current of 10-15 A. To determine source reliability, statistics on failures for 20 cathodes operating at high-voltage accelerators. Time to failure for a separate cathode is 250 hrs - 15.500 hrs. The total time to failure for 20 cathodes is 88389 hrs, and a number of failures is 7. 2 refs.; 2 figs.

8956 (JINR-D—9-87-105-Vol.2, pp 71-74) **Phase characteristics of negative heavy ion beams from a source with sputtering.** Troshin, A.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Phase characteristics of negative heavy ion beams from a source with sputtering are presented. The negative heavy ion source is designed for the UKP-2-1 accelerating complex and it permits to obtain beams with current up to 1-40 mkA depending on the ion type obtained. Measurements of phase characteristics are carried out, when the source with copper, aluminium, and steel sputtering targets operates. Cross sections of the beam phase volume obtained with different systems of initial formation are presented. Measurements are carried out when sputtering copper target, ion energy is 20 keV. The effective emittance of the beam obtained from the source with the sputtering target without a cone from the side of an extracting electrode is 12 mmxmradx√MeV at 80% level, at total beam current 15 mkA. The results obtained show that the source with cesium positive ion beam target sputtering, with 2.5 keV energy provides negative heavy ion beam production with parameters required for injection in the UKP-2-1 accelerator, and it can be used for another charge-exchange accelerators. 3 refs.; 3 figs.

8957 (JINR-D—9-87-105-Vol.2, pp 75-78) **Variable characteristics of an electron source with high brightness.** Vyaz'menova, G.A.; Svistunov, Yu.A.; Tikhomirov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results of numerical simulation of a self-consitent problem on field determination and particle dynamics in an electron gun of high brightness are presented. Tolerances for electrode shape deviation from the given one are determined. Deformations of electrons in the near-the-cathode region are shown to affect particle dynamics. 6 refs.; 5 figs.

8958 (JINR-D—9-87-105-Vol.2, pp 79-83) **Electron-optical system of the IMI-1 multicharged ion source.** Abdul'manov, V.G.; Kolokol'nikov, Yu.M.; Meshkov, I.N.; Sharapa, A.N. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-861027i—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results of tests of the IMI-1 multicharged electron-beam ion source developed for the B-5 synchrotron accelerating complex are described. The method of the IMI-1 electron-optical system alignment is presented. Losses of beam current in passing through the electron-optical system under mode without recuperation and with recuperation of the electron beam are presented. Average electron beam density 1x10/sup 3/ A/cm/sup 2/ is reached at 24 current. The electron beam perveance in a collector reaches 37 mkA/B/sup 3/2/ at 1.5 A current. 5 refs.; 3 figs.

8959 (JINR-D—9-87-105-Vol.2, pp 84-87) **Ion sources for the UKR-2-1 charge-exchange accelerator.** Golubev, V.P.; Nikiforov, S.A.; Troshikhin, A.G.; Ehl'gardt, R.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Performance of a negative heavy ion source with target working medium sputtering by Cs/sup +/ ions and a duoplasmatron to produce H/sub 1//sup -/ ion beams and inert gas atoms are described. The ion sources are designed for the UKP-2-1 heavy ion charge-exchange accelerator with up to 2 MeV energy (single-charged ions) and up to 50 mkA current. 4 refs.; 2 figs.; 1 tab.

8960 (JINR-D—9-87-105-Vol.2, pp 262-264) **Proton extraction from a cyclotron in the energy range of 950-1300 MeV on the base of the Q/sub r/=2.** Sarkisyan, L.A.; Chernyshenko, T.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Consideration is given to the change, taking place during dynamic passage of the Q/sub r/=2 integer resonance of the amplitude of induced radial proton oscillations, obtained on the base of calculations according to the complete system of equations of motion and on the base of analytical linear investigation. Calculations were conducted for two cyclotron parameters, depending on the second harmonic of magnetic field at 3 MeV energy gain per turn. It is shown that sufficient radial separation between successive beam turns can be achieved in order to install the deflector and de-

flect 995, 1116, 1154,1169 and 1268 MeV protons. As energy grows, the deflector is positioned into the region of large radii and the deflector voltage is being increased. The suggested methods for the beam extraction on the base of integer resonance are noted for technical simplicity and flexibility as compared to existing ones. 13 refs.; 2 figs.

8961 (JINR-D—9-87-105-Vol.2, pp 336-338) **Development of the IHEP booster beam injection system.** Myaeh, Eh.A.; Stolpovskij, S.V.; Schastlivtsev, S.V.; Tolpekin, V.N.; Troyanov, E.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

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A brief description of the IHEP synchrotron booster injection system equipment is given and results of experiments on two-turn injection are presented. The circuit of kicker-magnet switching is provided. At linear accelerator current of 80 mA the two-turn injection ensured the accumulation of 1.3 x 10/sup 12/ proton/booster cycle; the total (per 29 injection cycles into the main accelerator) intensity of the accelerated beam in the booster bunch exceeded 2 X 10/sup 13/, which is far in excess of the needs of the U-70 accelerator presently. 3 refs.; 4 figs.

8962 (JINR-D—9-87-105-Vol.2, pp 346-352) **Development of extraction systems and particle channels for using IHEP proton synchrotron high intensity.** Ado, Yu.M.; Afonin, A.G.; Galyaev, N.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of the initial period of booster intensity mastering using new particle channels and experimental installations are reported. Plans for further development of systems of beam extraction and particle channels for the IHEP proton synchrotron are presented. New particle channels 21 and 23 operating with slow extracted protons are put into operation. Channel 21 is attached to neutrino channel 8 along which both slow and fast extraction of protons is realized. Slow extraction proton beam is deflected in the direction of channel 21 by pulse magnets which ensure the operation of both channels (one with fast and the other with slow extraction) in each acceleration cycle. Channel 23 is designed for the operation in neutrino beams using the labelling method. Methods of the accelerated beam extraction along three directions and its intensity distribution over the channels, as well as the number of simultaneously operating installations in each channel, are presented. 3 refs.; 4 figs.; 3 tabs.

8963 (JINR-D—9-87-105-Vol.2, pp 371-373) **Estimation of radiation loadings during slow extraction of relativistic nuclei from a nuclotron.** Zajtsev, L.N.; Nikulin, S.P.; Syrejshchikov, A.E. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Calculation results of radiation doses due to nuclei losses in the system of beam slow extraction and Nuclotron superperiod, have been presented for the first time. It was assumed, that the particles extracted can interact only with electrostatic septum, which is tungsten foil 0.3 mm thick and 3 m long. Admissible intensities of Nuclotron beam for pulse duration of 10/sup -3/ and is due to overheating of dipole superconducting coil, are presented. In the range of the maximum value the dose in the dipole is mainly formed at the expense of beam nuclei, which have escaped from the septum due to Coulomb scattering. The calculations have shown that technological protection of the dipole coils is effective only for heavy nuclei at low energies due to comparatively wide (10 - 100) mrad angle of particle impinge. 5 refs.; 3 figs.

8964 (JINR-D—9-87-105-Vol.2, pp 409-410) **Study on polymer films and metal foils during thermal-radiation effects of extracted proton beams.** Gurov, M.M.; Solov'ev, V.N.; Sorokin, V.A. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of theoretical and experimental investigation of thermoradiation loadings on materials and their lifetime in structures of pressurized partition in proton accelerator beam extraction channels are presented. Experimental testing of determination results of material lifetime in the pressurized partitions conducted using films of polyimide and its compositions with fiber glass fabric at proton beam intensity up to 3 x 10/sup 12/ proton/momentum has shown that the determination error of material lifetime is within 30.0 %. According to the calculation results it was ascertained that polyimide-based materials 100-200 μm thick at the beam intensity 3 x 10/sup 13/ proton/momentum can be used in partitions with the radius of 50.0 mm in the IHEP extracted beam channels for 700 h. The lifetime of titanium partitions 60 μm thick under the same conditions proved to be 10-15 times higher. 4 refs.

8965 (JINR-D—9-87-105-Vol.2, pp 257-261) **Method for calculation of accelerator resonators and its expermental test.** Bespalov, A.N.; Kuznetsov, Yu.A.; Glazov, A.A.; Zaplatin, E.N. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A new three-dimensional program, containing the solution of the problem of computer mass memory, is suggested to be used for calculation of the resonator of the DC-1 deuteron cyclotron. Finite difference problem and the method of its solution are considered. The method was applied for calculating principle mode of accelerating delta-resonator. Theoretical and experimental dependences of resonator eigenfrequency on resonator height and on the gap of the trimmer are presented. Radial distributions of the relative voltage in accelerating gap are presented. 6 refs.; 5 figs.; 1 tab.

8966 (JINR-D—9-87-105-Vol.2, pp 273-277) **Progress in development of superconducting materials for accelerators.** Nikulin, A.D. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of fabrication of superconducting materials for accelerators by the USSR industry are presented. At present it produses various multi-fibre superconductors on the basis of deformed niobium-titanium alloys and Nb/sub 3/Sn intermetallic compound. A special place in the large group of technical superconductors is occupied by composite conductors, designated for magnetic systems of charged particle accelerators. Progress in improvement of critical current density of NT-50 alloy base superconductors is shown. 4 refs.; 3 figs.; 2 tabs.

8967 (JINR-D—9-87-105-Vol.2, pp 278-284) **Radiation shielding of superconducting magnets on proton accelerators.** Drozhdin, A.I.; Maslov, M.A.; Mokhov, N.V.; Myznikov, K.P.; Fedotov, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Problem of radiation heating of superconducting magnets was considered with respect to the 3 TeV UNK under construction in the IHEP. Means of radiation shielding of magnets and equipment were developed. It is shown that joint efficiency of shielding means, based on interception of low energy and neutral components, as well as high-energy protons of secondary radiation, de-

pends on specific magneto-optical accelerator structure. The value of energy release decrease in ring magnets achieves 500-1000 for the superconducting coils of the UNK as a result of using these means. The sufficient reserve of serviceability of superconducting magnets can be achieved if magnets with the maximal critical parameters are located in the points of elevated level of radiation heat releases. Application of system of two shorter collimators, located from each other at the distance of the order of several meters and possessing different aperture, enables to achieve shielding effect of the order of 20-40. Local thickening of vacuum chamber can be used in some particular cases. 14 refs.; 7 figs.

8968 (JINR-D—9-87-105-Vol.2, pp 285-290) **Investigation of the chain of 5T full-scale superconducting magnets.** Ageev, A.I.; Aleksandrov, G.M.; Aleksandrov, A.G. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

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Bench investigations of the chain of dipoles with warm magnetic screen, connected in series, are being conducted in the framework of the IHEP program of the UNK superconducting magnet simulation. At the given stage conditions of accidental magnet transition to the normal state are being investigated. The study of processes of propagation of the normal phase, temperature fields and pressure growth dynamics, processes of energy and helium evacuation from magnet chain is given. Results of measuring electric and nonstationary processes in the chain during transition of one of superconducting magnets to the normal state are presented. 6 refs.; 7 figs.

8969 (JINR-D—9-87-105-Vol.2, pp 291-295) **Study on the rate characteristics of the UNK superconducting dipoles.** Andreev, N.I.; Vasil'ev, L.M.; Gridasov, V.I. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of investigating the dependence of transition current of superconducting (SC) models of the UNK dipoles to normal state on the rate of magnet current supply are presented. These investigations are caused by the necessity for providing stability of SC magnet operation both in the running UNK cycle and under accidental conditions during fast extraction of current from accelerator magnetic system. The greater part of investigations of rate characteristics was conducted with the use of short models with successive testing of obtained results with respect to full-scale SC magnets. Analysis of calculation and experimental results showed that application of SC cable with 8-10 mm spacing of fiber twisting and the value of transverse resistance between conductors of not less than 2X10/sup -7/ ΩXmm enables to elemenate the dependence of current of SC dipole transition to the normal state on the rate of current supply in 0-600 A/s range, including both running rates in the UNK cycle and possible rate of current change in magnets under accidental conditions. 5 refs.; 5 figs.; 1 tab.

8970 (JINR-D—9-87-105-Vol.2, pp 296-299) **Simulation of cooling and heating processes of the UNK superconducting dipole magnets.** Abramov, A.G.; Ageev, A.I.; Bozhko, Yu.G.; Gusak, V.I.; Dajkovskij, A.G.; Zhirnov, A.V.; Proshchaev, E.G.; Tarasov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Investigation of processes of cooling and heating of superconducting (SC) accelerators is related both with the choice of the scheme and equipment of cryogenic supply system and with determination of structural strength of accelerator units after temperature gradients occur in them. Longitudinal arm size of SC magnets in the UNK exceed sufficiently the cross size. This enables to study separately longitudinal and transverse thermal processes and then to consider mutual errors when analyzing cooling and heating processes in general. Calculation of conditions of cooling and heating of the UNK SC dipoles with cold yoke was conducted for two technological periods: scheduled one, when all the UNK magnets are cooled and repair one, when heating and cooling is conducted only for the group of magnets, which contains poor magnet. Technique for calculating temperature field in the cross section of SC dipole is based on solution of two-dimensional parabolic heat conduction equation for nonstationary case with regard to structural peculiarities of SC magnet. Finite element method with the use of implicit circuit (modified HAST package) was applied for the solution. 6 refs.; 4 figs.

8971 (JINR-D—9-87-105-Vol.2, pp 300-304) **Technique and results of investigations of magnetic characteristics of type A experimental dipoles and type B first stage dipoles of the UNK.** Nikiforovskij, A.V.; Smirnov, P.V.; Titov, V.A.; Fedorishin, Yu.M.; Fomin, M.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Dipoles of type A and B with cross sections of operating area equal to 60X70 and 43X91 mm and 5800 mm length represent one of the basic elements of ring electromagnet of the UNK first stage. Investigation of preproduction dipole series were conducted with the use of developed technique for magnetic measurements, precise equipment, on-line measuring system, enabling to measure under statistical and pulsed conditions of magnet excitation, applying induction field converters. It is shown that integral value of heterogeneity doesn't exceed the permissible value at all induction levels. Contribution of residual field at the level of injection field doesn't bring field heterogeneity beyond the permissible level. The value of the first harmonic of residual field equals 3.2X10/sup -3/ T in A magnet and 4.5X10/sup -3/ T in B magnet. The dependence of effective length on induction is presented. The results show that relative change of length equals 1.1X10/sup -3/, which is close to tolerance. Measurements of the integral value of rotation angle of the medium plane showed that its value lies within the range of 0.05-2.0 mrad for produced series of magnets. 3 figs.; 4 tabs.

8972 (JINR-D—9-87-105-Vol.2, pp 305-307) **Superconducting dipole with a cold magnetic shield.** Vasil'ev, V.L.; Eregin, V.E.; Kashikhin, V.S.; Kosyakin, M.N.; Titov, V.A.; Shan'gin, V.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A new design of the UNK magnet with magnetic shield located inside of the cryostat and having temperature close to the temperature of liquid helium, was developed. It was assumed that critical current density in superconducting NbTi alloy filaments was equal to 2.3X10/sup 5/ A/cm/sup 2/ at B=5.0 T and T=4.2 K. Main parameters of suggested version of dipole magnet are presented. The design of suggested dipole version is distinguished by the absence of direct contact between magnetic shield iron and the flow of cooled helium. The improved rigidity of the system of winding containment due to external band, enclosing the magnetic shield, is the important feature of the dipole. Mechanical stresses in magnetic shield iron and external band don't exceed 500 kg/cm/sup 2/ at the maximal excitation current. Computer analysis of conditions of dipole precooling and preheating during scheduled UNK shut-down showed that absence of direct contact of magnetic shield iron with helium wouldn't prevent the normal operation of the system of the UNK superconducting magnet cryostating. 3 refs.; 3 figs.

8973 (JINR-D—9-87-105-Vol.2, pp 308-311) **Calculation of helium pressure rise in the UNK magnets during transition to the normal state.** Vasil'ev, V.N.; Dinaburg, L.B.; Kalinin, V.V.; Titov, V.A.; Shatil', N.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Consideration is being given to the problems of helium evacuation from the UNK cryostats for the version of magnet structure, where cooling channels are located in the ring gap between cold magnetic shield and winding unit and in the internal gap of superconducting coil. Calculation of the dynamics of helium outflow from magnet channels and valves was conducted by numerical method for real thermodynamic helium properties. System with one-dimensional equations of energy and helium flow dynamics in streched channels was solved in conjugation with the equation of energy, transformed to the normal state of the coil. Typical conditions of accidental energy output were taken into account. It was assumed that coupling between neighboring magnets along the helium flow was absent. Technique for calculating hydrothermodynamic processes in channels of superconducting magnets during their transition to the normal state enabled to determine requirements for cryostat design, the number and cross sections of valves and tubes for helium evacuation from the UNK magnet chains. The conducted investigations showed that UNK cryastats should be designed for 1+2 MPa pressure. In this case the number of safety valves, located in accelerator ring, can be reduced, heat input can be decreased and the volume of operations, related with valve replacement and adjustment, can be reduced as well. 2 refs.; 2 figs.

8974 (JINR-D—9-87-105-Vol.2, pp 312-315) **Cryostating of superconducting magnets with a cold magnetic shield.** Vasil'ev, V.N.; Volkov, A.F.; Dinaburg, L.B.; Kalinin, V.V.; Titov, V.A.; Nikolishvili, T.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Cryogenic aspects of UNK operation when using magnets with a cold magnetic shield for a design variant, where channels of two-phase and single-phase helium are placed in a ring gap on the boundary between the magnetic shield and a superconducting winding unit, are considered. The parameters of magnet cryostating system for three modes of UNK operation: cooling (heating), cryostating and magnet transition to the normal state - are determined. The results of calculation of pressure growth dynamics in the centre and on the edges of channels of the UNK 6-meter magnet when winding transfers to the normal state, are presented. Tube diameters for helium evacuation and safety valves equal 25 and 35 mm. The calculational results have shown that the magnet structure suggested with cold iron satisfies the requirements of reliable operation of UNK ring superconducting magnet under all cryogenic conditions. 1 ref.; 3 figs.; 1 tab.

8975 (JINR-D—9-87-105-Vol.2, pp 316-319) **Precise calculations of the SPIN synchrotron magnets two-dimensional fields.** Ajryan, Eh.A.; Zhidkov, E.P.; Fedorov, A.V.; Khoromskij, B.N.; Shelaev, I.A.; Yudin, I.P.; Yuldashev, O.I. (Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Dependence of two-dimensional field distribution on the current value in the excitating superconducting winding for dipole and quadrupole superconducting magnets of the SPIN synchrotron regular period is investigated. The problem of achievable accuracy of calculations carried out is analysed. Numerical algorithms on sequencies of thickening grids presented as the GRIDS program complex are used for investigations. 11 refs.; 5 figs.; 3 tabs.

8976 (JINR-D—9-87-105-Vol.2, pp 330-332) **Vacuum chamber and pumping-out system of the ITEP proton-heavy ion synchrotron.** Zudinov, Yu.B.; Ivanov, P.E.; Kruglov, B.I.; Onosovskij, K.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results of investigation on the application of nonsputter-ion pump to obtain 5x10/sup -10/ Pa vacuum in a vacuum chamber of a heavy-ion synchrotron are presented. The design of the vacuum chamber and the pumping-out system are described. Four supervacuum posts are arranged in every of eight periods of the ring vacuum chamber. The supervacuum post includes the NMD-0.4 (or NMD-0.16) magnetic discharge pump and the sputter-ion pump based on porous titanium. The pumping-out of the vacuum system from the atmospheric pressure up to 10/sup -2/-10/sup 3/ is carried out by the post of preliminarily pumping-out including the NVZ-20 force pump, the TMN-200 turbomolecular pump and the NMDO-0.25 (NORD-250) magnetic-discharge "rough" pump with additional water-cooling. Measures on preparation of the chamber surface, degassing and activation of the getter, are described. 2 figs.

8977 (JINR-D—9-87-105-Vol.2, pp 333-335) **Cryopumping system of the JINR synchrotron vacuum chamber.** Vasilishin, B.V.; Zinov'ev, L.P.; Kulikov, I.I.; Monchinskij, V.A.; Pikin, A.I.; Semenyushkin, I.N. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The second stage of the cryopumping system (CPS) of the JINR synchrotron vacuum chamber is described. The results of the nucleus acceleration and system testing are presented. The residual gas pressure average in the vacuum chamber perimeter was improved from 3.5x10/sup -4/ Pa till 5x10/sup -5/ Pa. The liquid helium flow rate is 150 l/h at 22 K at the output from cryopanels. So, the CPS power produced by helium is about 600 W. The liquid nitrogen flow rate is about 200 l/h. Time for CPS commissioning is 5 hours. The CPS is used in silicon and magnesium acceleration using a laser ion source. At Mg/sup 12+/ nuclei acceleration the increase of intensity is approximately 10/sup 3/ due to the vacuum improvement by means of CPS. 4 refs.; 4 figs.; 1 tab.

8978 (JINR-D—9-87-105-Vol.2, pp 343-345) **Application of guiding azimuthal-periodical magnetic field with multiple harmonics in modification of cyclic accelerators.** Zvontsov, A.A.; Zrelov, Yu.D.; Kaz'min, V.P. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of cyclotron guiding magnetic field simulation to increase its focusing properties are presented. The increase in the flatter is achieved by the introduction of auxiliary harmonic which is the multiple frequency of the first harmonic. With the coil magnetomotive force chosen the given field is formed by the change in the azimuthal length and height of some crests. Electromagnet of crest-type with changeable crest poles is developed and produced to check the results presented. The design of the poles permits to change the number, height, shape and azimuthal position of the crests. Alternating current mains is used for supplying electromagnet. The measurement of field intensity at the radius fixed was made every 5 deg using a measurement coil. The measurement results confirmed completely the possibility of magnetic field formation with regularities mentioned. 2 refs.; 3 figs.

8979 (JINR-D—9-87-105-Vol.2, pp 374-376) **Polymercement insulation material for magnet coils with increased radiation stability.** Berenyuk, M.A.; Zaruchejskij, V.G.; Il'in, A.G.; Pokrovskij, K.K.; Popov, K.N.; Solov'ev, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Polymercement (PC) is a material on the basis of composite binding material, comprising organic polymer and inorganic binding substance, which polymer component forms an independent structural element in solidified material. The main idea of PC use consists in the separation of insulation material functions between PC components. The mineral component ensures the long-term mechanical properties and radioresistance of the coil, while the polymer component considerably improves electrophysical properties of the insulation. Results of the PC optimal composition selection according to mechanical, dielectric and technological properties are presented. The principle possibility to use PC as an electroinsulation material in radiation-loaded elements and units of accelerators is shown. The complex of PC properties permits to recommend it not only for the use in accelerators, but also in any other nuclear facilities. 3 refs.; 2 figs.

8980 (JINR-D—9-87-105-Vol.2, pp 389-392) **Calculation of induced radiation of coolant in systems for cooling high-energy charged particle accelerator irradiated equipment.** Gorbatkov, D.V.; Kryuchkov, V.P.; Kuchinin, S.L.; Rastsvetalov, Ya.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

An attempt is made to develop the method of calculation of coolant activation in systems of accelerator irradiated equipment. Water was considered as a coolant. The calculation technique is realized using the ATOS computer program. The program permits to calculate the induced activity of coolant in the cooling systems, as well as that of the air in ventillation systems of the accelerator. Possibilities of the calculation technique developed are shown using as an example the calculation of induced coolant activity in the cooling system of booster magnetic elements. 3 refs.; 3 figs.; 1 tab.

8981 (JINR-D—9-87-105-Vol.2, pp 406-408) **Development of casting cement compositions for electric insulation of magnetic systems.** Afanas'ev, V.V.; Korenevskij, V.V.; Pisachev, S.Yu.; Zaruchejskij, V.G.; Berenyuk, M.A. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The work is aimed at selection of an effective plasticizer on the basis of literature data, as well as optimum mass of the plasticizer as applied to belite-aluminate cement, and at the study of its effect on physicomechanical and dielectric characteristics of the cement stone to produce UNK pulse magnet with radioresistant cement insulation. The best results with the use of cements with the increased content of aluminates were obtained in case of C-3 naphthalene-formaldehyde-superplastifier. It is shown that the introduction of the C-3 superplastifier into cement mixture in the quantity of 1 % increases solution plasticity, compression strength, dielectric characteristics in case of air-humid solidification with periodic moistening. 2 refs.; 1 tab.

8982 (JINR-D—9-87-105-Vol.2, pp 265-267) **Requirements for recording equipment accuracy dependending on procedures of tuning complex magneto-optical systems.** Samojlov, A.V.; Volkov, B.S.; Majorov, A.A.; Shevtsov, P.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Approach for solution of problems of analyzing tuning methods of magneto-optical systems (MOS) for particle transport in the accelerator is considered. The approach is applied to analysis of MOS tuning methods, taking algorithm of correction of beam motion direction as an example. The suggested approach is rather simple and at the same time powerful means of analyzing tuning methods. It enables, without recourse to experiments, to compare methods, to reveal 'the weakest points' of the method to plan the required accuracy of measurements. 5 refs.

8983 (JINR-D—9-87-105-Vol.2, pp 268-270) **System for control and monitoring of primary beams of the Moscow meson factory experimental complex.** Gorbunov, V.K.; Grachev, M.I.; Samojlov, A.V.; Mikheev, E.N.; Rybin, V.M.; Tsyplyakov, A.P. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

On-line system for control and monitoring of H/sup +-/ beams of the Moscow meson factory experimental complex is described. Configuration of the control and monitoring system is presented. The system is designated for H/sup +-/ beam transport to the targets with minimal losses and possibility of parallel independent operation of several experimental devices. The system is based on two microcomputers of SM 1420(SM 1700) type. 8 refs.; 3 figs.

8984 (JINR-D—9-87-105-Vol.2, pp 325-329) **On-line system for separate field correction of the U-10 synchrotron magnetic units.** Alekseev, N.N.; Pushkin, E.V.; Ryabtsev, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The updated on-line system for individual connection of the field magnetic units of the U-10 synchrotron ring magnet is described. Modernization includes the change of rheostats for a current transistor requlators controlled by a computer. 96 current regulators with control electronics frames are placed in the "Vishnya" console. The system permits to increase synchrotron acceptance for the injection moment approximately 1.5 times and due to this to increase the accelerated beam intensity more than by 20%. 1 ref.; 5 figs.

8985 (JINR-D—9-87-105-Vol.2, pp 339-342) **On-line system for measurement of beam loss azimuthal distribution in the ITEP proton synchrotron.** Ryabtsev, A.S.; Uvarov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

On-line measurement system of beam loss azimuthal distribution in the ITEP synchrotron using one measurement channel is described. The problem of information transmission from a moving detector to the unit of processing electronics attached to a computer was solved using a telemetric communication channel. The system thus produced proved to be simple and reliable. The tele-

metric channel transmission band selected (approximately 1 kHz) and a wide dynamic range (approximately 10/sup 5/) permit to process the signal of particle loss during the whole cycle of beam acceleration and extraction. The radiation detector is a scintillator with a photomultiplier. It is installed on a platform of radial bridge crane, which travels in the process of measurement above magnetic path of the synchrotron. 2 refs.; 3 figs.

8986 (JINR-D—9-87-105-Vol.2, pp 368-370) **Comparison of calculational and experimental characteristics of secondary radiation fields near thick targets irradiated by light relativistic nuclei.** Bamblevskij, V.P.; Krylov, A.R.; Timoshenko, G.N. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Differential characteristics of secondary radiation fields of hadrons from thick copper and lead targets, irradiated with 3.65 GeV/nucleon protons and /sup 12/C nuclei, obtained by calculations using the J0NCAS program and experimentally, are compared. The "firestrick" model is used in the program to describe nucleus-nucleus interactions, according to which double differential cross sections of neutrons, protons and PI-meson production in A-A collisions were calculated. Double differential cross sections of hadron production in hadron-nucleus interactions were calculated by the D2N2 program. 7 refs.; 4 figs.

8987 (JINR-D—9-87-105-Vol.2, pp 377-380) **On-line system for radiation control at the Serpukhov synchrotron.** Borodin, V.E.; Barejsha, F.F.; Kuz'menko, V.G. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The on-line system for radiation control (OLSRC) at the U-70 Serpukhov synchrotron is designed. The OLSRC hardware is synchronized with the U-70 operating cycle. The OLSRC software is developed on the base of the PSXIIS operating system. OLSRC emergency information is accompanied by audio signalling. Hardware and software implemented in OLSRC improved the working conditions and relieved the personnel of tiresome waste of labour concerning constant control for the alarm system of. 8 refs.; 2 figs.

8988 (JINR-D—9-87-105-Vol.2, pp 396-399) **High-energy hadron spectra on the 70 GeV proton accelerator.** Belogorlov, E.A.; Krupnyj, G.I.; Kuznetsov, A.A.; Lebedev, V.N.; Rastsvetalov, Ya.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A method to determine radiation spectra hardness behind massive (about 2 m thick) concrete and steel shielding of the Serpukhov accelerator is suggested. On the basis of the Bonner method with the supplement of subsidiary carbon detector the test determination of high-energy neutron spectra expected behind the shielding was conducted. Analysis of the experimental results obtained and literature data on high-energy spectra behind the accelerator shielding has shown that the ratio of the /sup 11/C carbon-containing detector response to the thermal neutron detector response in 12-inch polyethylene sphere unambiguously characterizes the spectrum hardness. 13 refs.; 5 figs.; 2 tabs.

8989 (JINR-D—9-87-105-Vol.2, pp 415-418) **Spectral-angular characteristics of charged particles behind the IHEP synchrotron biological shield at the energy of primary protons of 70 GeV.** Krupnyj, G.I.; Kuptsov, V.N.; Lebedev, V.D.; Majorov, V.D.; Peleshko, V.N.; Rastsvetalov, Ya.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

To study characteristics of charged particles behind the Serpukhov accelerator shielding an on-line spectrometer, permitting to identify 20-400 MeV protons at the background of other particles, is developed. The spectrometer is based on simultaneous measurement in the detector of specific losses and energy release of a particle in an E-detector. The spectrometer comprises a scintillation counter telescope and the E-detector. The studies of a charged component behind the 2-meter concrete shielding at the energy of primary protons of 70 GeV permitted to make the following conclusions: - angular distributions of 20-400 MeV protons are of a more anisotropic character than those of all charged particles; - proton number in the flux of charged particles varies with the orientation of the spectrometer axis at different angles to the shielding surface, and the maximum value is attained in the maximum of angular distribution; - a good correlation of neutron and charged particle monitor readings testifies to the existence of genetic relation between neutrons and charged particles; - the ratio of fluences of 20-400 MeV protons and >20 MeV neutrons in the given geometry constitutes 4.3 % and of all charged particles and neutrons - 9.4 %. 13 refs.; 3 figs.; 1 tab.

8990 **(LA-UR—88-2498) Preliminary description of the ground test accelerator cryogenic cooling system.** Edeskuty, F.J.; Stewart, W.F. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 15p. (CONF-890102—2). NTIS, PC A03/MF A01 - OSTI. Order Number TI88016222/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The Ground Test Accelerator (GTA) under construction at the Los Alamos National Laboratory is part of the Neutral Particle Beam Program supported by the Strategic Defense Initiative Office. The GTA is a full-sized test facility to evaluate the feasibility of using a negative ion accelerator to produce a neutral particle beam (NPB). The NPB would ultimately be used outside the earth's atmosphere as a target discriminator or as a directed energy weapon. The operation of the GTA at cryogenic temperature is advantageous for two reasons: first, the decrease of temperature caused a corresponding decrease in the rf heating of the copper in the various units of the accelerator, and second, at the lower temperature the decrease in the thermal expansion coefficient also provides greater thermal stability and consequently, better operating stability for the accelerator. This paper discusses the cryogenic cooling system needed to achieve these advantages. 5 figs., 3 tabs.

8991 **(LBL—25139) Magnetic field decay in model SSC dipoles.** Gilbert, W.S.; Althaus, R.F.; Barale, P.J.; Benjegerdes, R.W.; Green, M.A.; Green, M.I.; Scanlan, R.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 4p. (CONF-880812—32). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004791/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

We have observed that some of our model SSC dipoles have long time constant decays of the magnetic field harmonics with amplitudes large enough to result in significant beam loss, if they are not corrected. The magnets were run at constant current at the SSC injection field level of 0.3 tesla for one to three hours and changes in the magnetic field were observed. One explanation for the observed field decay is time dependent superconductor magnetization. Another explanation involves flux creep or flux flow. Data are presented on how the decay changes with previous flux history. Similar magnets with different Nb-Ti filament spacings and matrix materials have different long time field decay. A theoretical model

using proximity coupling and flux creep for the observed field decay is discussed. 10 refs., 5 figs., 2 tabs.

8992 **(LBL—25693) Laced permanent magnet quadrupole drift tube magnets.** Feinberg, B.; Behrsing, G.U.; Halbach, K.; Marks, J.S.; Morrison, M.E.; Nelson, D.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00093. 3p. (CONF-881049—47). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004699/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

A laced permanent magnet quadrupole drift tube magnet has been constructed for a proof-of-principle test. The magnet is a conventional tape-wound quadrupole electromagnet, using iron polepieces, with the addition of permanent magnet material (neodymium iron) between the poles to reduce the effects of saturation. The iron is preloaded with magnetic flux generated by the permanent magnet material, resulting in an asymmetrical saturation curve. Since the polarity of the quadrupole magnets in a drift tube linac is not reversed we can take advantage of this asymmetrical saturation to provide greater focusing strength. The magnet configuration has been optimized and the vanadium permendur poles needed in a conventional quadrupole have been replaced with iron poles. The use of permanent magnet material has allowed us to increase the focusing strength of the magnet by about 20% over that of a conventional tape-wound quadrupole. Comparisons will be made between this magnet and the conventional tape-wound quadrupole. 3 refs., 5 figs.

8993 **(SLAC-PEP-NOTE—213) Critique of PEP interaction building design.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). [1988]. Contract AC03-76SF00515. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004588/JAW.

This note reviews the design of the interaction region 2, 8 and 12 buildings from the viewpoint of shielding adequacy, available space and amenities provided. Conclusions are drawn that the present design is not the best way to satisfy the requirements. An alternative design is proposed which, it is claimed, is a better solution to the problems without an increase in cost.

8994 **(SLAC-PUB—4733) Relativistic klystron research for linear colliders.** Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fant, K.S.; Fowkes, W.R.; Herrmannsfeldt, W.B.; Higo, T.; Hoag, H.A.; Koontz, R.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 6p. (CONF-8806243—10; CONF-881049—45). NTIS, PC A02 - OSTI. Order Number DE89004969/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

Relativistic klystrons are being developed as a power source for high gradient accelerator applications which include large linear electron-positron colliders, compact accelerators, and FEL sources. We have attained 200 MW peak power at 11.4 GHz from a relativistic klystron, and 140 MV/m longitudinal gradient in a short 11.4 GHz accelerator section. We report here on the design of our relativistic klystrons, the results of our experiments so far, and some of our plans for the near future. 5 refs., 9 figs., 1 tab.

8995 **(SLAC-PUB—4782) Final focus supports for a TeV Linear Collider.** Ash, W.W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 2p. (CONF-8806243—8). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004972/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

Final focus quadrupoles supported from structures in the endcap region of a physics experiment appear to meet the high-frequency vibration and stability criteria for a TeV Linear Collider (TLC). The support stays within a ten-degree cone, minimizing interference with the experimental apparatus. 3 refs., 3 figs.

8996 **(SLAC-PUB—4804) Calculation of detector backgrounds at TeV linear colliders.** Himel, T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 2p. (CONF-8806243—6). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004770/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

It is necessary to carefully design masks and beam lines to prevent the high energy physics detector from being inundated with background particles from a high energy linear collider. Presented here are preliminary calculations on two of the three expected backgrounds: photons from synchrotron radiation produced in the final focus quadrupoles, and electrons which lose energy due to bremsstrahlung and are then bent into a mask or quadrupole by the field of the opposite beam. The former can be controlled with proper masking. The latter may pose a problem, so further calculations are needed. Work was also done on the third expected source of background: electrons in the tail of the beam which hit masks where showers are made whose products enter the detector. This work was very preliminary and is not included in this write-up. All the calculations here are based on the 1 TeV center-of-mass linear collider design of R. Palmer and the final focus design of K. Oide which can be found in these proceedings. Extrapolations to other accelerator designs should be straightforward.

8997 **(UCRL—98539) Design considerations for ITER [International Thermonuclear Experimental Reactor] magnet systems.** Henning, C.D.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1988. Contract W-7405-ENG-48. 8p. (CONF-881031—51). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004782/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The International Thermonuclear Experimental Reactor (ITER) is now completing a definition phase as a beginning of a three-year design effort. Preliminary parameters for the superconducting magnet system have been established to guide further and more detailed design work. Radiation tolerance of the superconductors and insulators has been of prime importance, since it sets requirements for the neutron-shield dimension and sensitively influences reactor size. The major levels of mechanical stress in the structure appear in the cases of the inboard legs of the toroidal-field (TF) coils. The cases of the poloidal-field (PF) coils must be made thin or segmented to minimize eddy current heating during inductive plasma operation. As a result, the winding packs of both the TF and PF coils includes significant fractions of steel. The TF winding pack provides support against in-plane separating loads but offers little support against out-of-plane loads, unless shear-bonding of the conductors can be maintained. The removal of heat due to nuclear and ac loads has not been a fundamental limit to design, but certainly has non-negligible economic consequences. We present here preliminary ITER magnetic systems design parameters taken from trade studies, designs, and analyses performed by the Home Teams of the four ITER participants, by the ITER Magnet Design Unit in Garching, and by other participants at workshops organized by the Magnet Design Unit. The work presented here reflects the efforts of many, but the responsibility for the opinions expressed is the authors'. 4 refs., 3 figs., 4 tabs.

8998 **Disorder and diffusion in thin-film multilayers.** Saxena, A.M. (Brookhaven National Lab., Upton NY (USA)). *Proceedings of SPIE - The International Society for Optical Engineering;* **563**: 168-173(1985). Contract AC02-76CH00016.

Practical multilayers devices usually have some in-built imperfections that adversely affect their properties. An analysis of the diffraction properties of a multilayer, and its comparison with the results obtained from a theoretical model of a multilayer with imperfections, can given information about the type and magnitude of imperfections in the multilayer. This information can then be used to make multilayers with better characteristics. 10 references.

## 4304 Storage Rings

*REFER ALSO TO CITATION(S) 8811, 8823, 8827, 8854, 8911, 8913, 9072, 10098*

8999 (CERN—88-05) **Non-linear transverse dynamics for storage rings with applications to the low-energy antiproton ring (LEAR) at CERN.** Bengtsson, J. (European Organization for Nuclear Research, Geneva (Switzerland); Lund Univ. (Sweden)). 1 Aug 1988. 142p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704415/JAW.

A tensor equation has been used to derive the equations of motion for the curvilinear coordinate system customarily used for particle accelerators. A Hamiltonian formalism, expanded to third order in the canonical variables, has also been developed to describe the transverse motion in an accelerator. Time-dependent perturbation theory has been applied and computerized using a computer-algebra system. In particular, the perturbations due to magnetic sextupoles have been calculated to second power in the sextupole strength. The frequency spectra for the horizontal and the vertical betatron motion close to a single resonance have been calculated using time-independent perturbation theory. It has been shown that information about excited resonances and the type of driving field can be derived from the spectra. In particular, it is possible to obtain the amplitude and the phase of a given resonance. The results have been used to study the perturbations in the Low Energy Antiproton Ring (LEAR) at CERN.

9000 (JINR-D—9-87-105-Vol.1, pp 123-130) **Heidelberg test storage ring-an experimental facility.** Steffens, E. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

At Heidelberg, a small heavy ion Test Storage Ring (TSR) is under construction. It is designed to store heavy ion and proton beams from the existing tandem-linac accelerator combination. The ring will comprise an electron cooling system, internal targets and detectors for ions and photons. The first experiments will be on accumulation and cooling of heavy ion beams and on electron-ion interaction in the cooler region. An internal polarized hydrogen target is under development to test the idea of the filter target experiment. 28 refs.; 5 figs.

9001 (JINR-D—9-87-105-Vol.1, pp 335-338) **Study on the regimes of discharge treatment of the UNK first stage vacuum system section model.** Kiver, A.M.; Mirzoev, K.G.; Poroshkov, S.E.; Rogozinskij, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Discharge regimes in argon to degas the chamber surface are studied using the model of the vacuum system corresponding to a chamber section between the middles of UNK two neighbouring magnets. This model is characterized by the presence of the liner in the space connecting two chambers of ellyptical cross section with 43 x 91 mm and 60 x70 mm axes 3 mm each with 1.5 and 1.0 mm respectively, wall thickness. The values of parameters of various regimes recommended for UNK vacuum chamber treatment are given. It is shown that the liner produces no noticeable effect on preparation and keeping of the vacuum required. 2 refs.; 3 figs.; 1 tab.

9002 (JINR-D—9-87-105-Vol.1, pp 339-341) **Automation of vacuum control in charged particle storage rings.** Gudkov, B.A.; Yukhlin, V.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Description of an on-line system for measuring vacuum on the storage ring is presented. The system contains peripheral equipment and multichannel meters IVA-16. Vacuum control range is from 5x10/sup -11/ up to 6x10/sup -5/ T, measuring time in a single channel is 200 ms, measurement error is +-2%. Measurement of all the 16 channels is performed sequentially. Vacuum indicator characteristics are presented. 1 ref.; 4 figs.; 1 tab.

9003 (JINR-D—9-87-105-Vol.1, pp 342-344) **System for measuring magnetic fields using spin echo.** Zinevich, N.I.; Medvedko, A.S.; Sukhanov, D.P.; Shubin, E.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Description of an on-line system for magnetic field measurements on the storage rings using spin echo method is presented. In the system described the magnetic field measurement is performed in the following way. In a specimen with the required atoms (e.g. protons or lithium nuclei) spin echo is induced by effect of a pair of pulses. A NMR frequency echo-signal received from the transducer is transferred to a lower intermediate frequency where it is transformed into a digital form using analog-to-digital converter and then spectral analysis using Fourier fast transformation method is performed. Echo-signal frequency and magnetic induction values, corresponding to it are determined according to the spectrum calculated and to a certain heterodyne frequency. The system allows one to measure fields within 0.05-1 T range using two proton detectors (with 2.1-42 MHz frequency range). Relative measurement error does not exceed 3x10/sup -6/. The detecor tubes are 5 mm in diameter with 10 mm winding length and are encased into a copper shield. 3 refs.; 2 figs.

9004 (JINR-D—9-87-105-Vol.1, pp 347-352) **Colliding beam luminosity in the VEPP-2M electron-positron storage ring with a superconducting magnetic snake.** Vasserman, I.B.; Vorob'ev, P.V.; Gluskin, E.S. and others. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Results of measuring luminosity obtained using a switched on and switched off superconducting "snake", in the VEPP-2M storage ring are presented. Under 250 MeV energy and switched on "snake" the luminosity is increased 5.5 times and makes up o.2x10/sup 30/ cm/sup -2/xc/sup -1/. Space charge parameter dependence on the storage ring magnetic structure distortions introduced by the "snake" is investigated. Experiments on the quantitative study of betatron phase superposition modulation effect and on vertical $\beta$-function control at the colliding point are conducted. Application of "snake" synchrotron radiation is briefly described. 10 refs.; 5 figs.

9005 (JINR-D—9-87-105-Vol.1, pp 353-356) **Effect of small beam divergence on colliding effects in the VEPP-4 storage ring.** Temnykh, A.B. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Effect of minor beam orbit divergence at the beam interaction point on colliding effects is considered and experimental data obtained at the VEPP-4 storage ring are presented. It is stressed that in case when radial divergence at the colliding point is absent, sizes of regions with high particle losses are reduced. It is shown that exact radial orbit convergence at the place of colliding beam interaction at the VEPP-4 storage ring leads to an increase of the particle lifetime in the storage ring under operation near the colliding effect threshold. 6 refs.; 3 figs.; 1 tab.

9006 (JINR-D—9-87-105-Vol.1, pp 357-360) **Magnetic structure for HF monochromatization in the VEPP-4 storage ring.** Dubrovin, A.N.; Zholents, A.A. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A method of HF-monochromatization of the beam energy in front of the colliding point is considered as one of the trends in the further development of the VEPP-4 storage ring. Based on the high monochromatization parameter obtaining method considered a special magnetic structure for the VEPP-4 storage ring is proposed. Apart from obtaining a high monochromatization parameter the magnetic structure provides for matching with the rest of the storage ring and for creation of necessary beam parameters in resonators and at the colliding point. The special magnetic structure proposed provides for a possibility of HF-monochromatization realization at the VEPP-4 storage ring with 5 monochromatization parameter obtaining and for 5 time luminosity increase under the corresponding current increase. 2 refs.; 2 figs.

9007 (JINR-D—9-87-105-Vol.1, pp 361-365) **Optical scheme of beam-beam interaction region for the UNK colliding beams.** Balbekov, V.I.; Nosochkov, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The UNK design provides for the possibility of producing the colliding pp-bar beams with 0.4x3 TeV energies, pp-bar beamswith 3x3 TeV energies and {similar←to}10/sup 30/ cm/sup -2/ s/sup -1/ luminosity and in the remote future-pp beams with 3x3 TeV energies and {similar←to}10/sup 32/cm/sup -2/ s/sup -1/ luminosity. Optical schemes of colliding regions with small $\beta$-functions are considered. In compliance with the general principles of UNK magnetic structure construction these sections are completely "invisible", i.e. they possess a single transfer matrix and are dispersion correlated. 3 refs.; 3 figs.; 4 tabs.

9008 (JINR-D—9-87-105-Vol.1, pp 366-371) **Project of the VEPP-4M modification for experiments with longitudinally polarized beams.** Zholents, A.A.; Muratov, V.V.; Ehjdel'man, Yu.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A proposal concerning the VEPP-4M storage ring experimental internal modification for producing longitudinal spin orientation of electrons and positros at the colliding point is described. The longitudinal polarization method is based on the approach using solenoid spin rotators. In this sceme the vertical polarization direction is at first transferred into the horizontal one by the solenoid longitudinal magnetic field and then it is transferred into the longitudinal direction by the roation by 90 deg in a magnet with the vertical magnetic field. The symmetrical part of the scheme is used for the reconstruction of the vertical polarization direction. 9 refs.; 6 figs.

9009 (JINR-D—9-87-105-Vol.1, pp 171-174) **New RF system of the VEPP-3 storage ring.** Arbuzov, V.S.; Belov, A.N.; Belomestnykh, S.A. and others. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

A new RF system is constructed to ensure the operation of the VEPP-3 storage rings in two-bunch mode. The system comprises two accelerating resonators, three power amplifiers and control equipment. The first accelerating resonator of the second harmonics of beam repetition frequency presents a short-circuit coaxial line, consisting of two parts. The resonator has the following electric parameters: Q-factor 4000, characteristic resistance 12 Ohm, shunt resistance 48 Ohm, the 20 kV voltage peak amplitude in the gap. The second accelerating resonator is a vacuum one and it operates in two-mode regime at the frequencies of 72.54 and 20.15 MHz at the eighteenth and fifth harmonics. The power amplifier has the output power up to 120 kW. The resonators are equipped with devices for automatic tuning of their proper frequencies using servo-drives. 3 refs.; 4 figs.

9010 (JINR-D—9-87-105-Vol.1, pp 398-402) **Compensation of nonlinear disturbances of isochronous mode of the Moscow meson factory proton storage ring.** Nagaenko, M.G.; Severgin, Yu.P.; Shukejlo, I.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Nonlinear effects of longitudinal motion in the Moscow meson factory proton storage ring are investigated. Sextupole lenses of 20 cm length were introduced into the storage ring to compensate nonlinear effects. Gradients of lenses for effective compensation of the bunch longitudinal elongation are presented. 7 refs.; 2 figs.; 1 tab.

9011 (JINR-D—9-87-105-Vol.1, pp 411-415) **Coulomb effects in the proton storage ring of the Moscow meson factory.** Moiseev, V.A.; Ostroumov, P.N.; Severgin, Yu.P. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The results studying space charge effects occurring in betatron frequency spectra formation and in beam transverse emittance increase, in particle redistribution in real and phase spaces are presented for the Moscow meson factory proton storage ring. Study of slow and fast modes of beam extraction from the storage ring is carried out on the basis of a mathematical model using the method of "large" particles. Beam phase images as well as regions of betatron frequencies and betatron spectra are presented. 3 refs.; 3 figs.; 2 tabs.

9012 (JINR-D—9-87-105-Vol.2, pp 253-256) **Charge-exchange target of the Moscow meson factory proton storage ring.** Kazarnovskij, M.V.; Kurbangaliev, N.M.; Lobashev, V.M.; Moiseev, V.A.; Ostroumov, P.N.; Severgin, Yu.P. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Charge-exchange of H/sup -/ ions on carbon foil is suggested to use during the injection into the Moscow meson factory proton storage ring. Results of investigating effect of charge-exchange target on beam parameters on the storage ring are presented, and estimation of target service life and temperature conditions are given. Calculation probabilities of proton nuclear interactions in charge-exchange target are presented. It is shown that charge-exchange target affects sufficiently the stacked beam dynamics. Application of spiral injection into the storage ring at high number of turns of circulating beam during injection period is justified, because it enables to decrease sufficiently (approximately by an order) the average number of each proton passage through the target and therefore to reduce uncontrollable particle losses and improve storage ring radiation conditions. Carbon target of 0.3 mg/cm/sup 2/ thickness is proposed to be used for injection into proton storage ring of the Moscow meson factory. The expected efficiency of charge exchange on the target equals {similar←to}99%, uncontrollable beam losses {similar←to}10/sup -2/%, the increase root-mean-square emittance of stacked beam, caused by multiple passage

through the target, depending on operation mode {similar←to}(0.05+-0.3)%. 9 refs.; 1 tab.

9013 (JINR-D—9-87-105-Vol.2, pp 381-384) **Calculation of radiation fields in underground rooms and tunnels of the UNK.** Azhgirej, I.L.; Bajshev, I.S.; Kurochkin, I.A.; Maslov, M.A.; Mokhov, N.V.; Uzunyan, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Estimations of radiation situation in the UNK underground rooms are given: distributions of radiation sources during proton losses, fields of instant radiation, radiation loadings on insulation of conventional and superconducting magnets, dose rate of residual gamma-radiation. Measures for proton loss localization in the UNK rectilinear spaces are described. Radiation problems concerning transport channels, target and splitting stations of hadron and neutrino complexes, are solved in the same way as for the rectilinear spaces. 10 refs.; 4 figs.; 2 tabs.

9014 (JINR-D—9-87-105-Vol.2, pp 393-395) **Shielding efficiency of labirinths and shaft exits of the UNK.** Babkin, V.N.; Getmanov, V.B.; Kuznetsov, A.A.; Mitin, M.F.; Ob"edkova, N.A. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Certain construction solutions directed at the increase of shielding efficiency of transport communication shafts, connecting experimental rooms and subsidiary rooms of high-energy accelerator, are considered. Design solutions of shielding of surface buildings, which are a part of engineering buildings, are also considered. The design solutions for the labyrinths considered are approximated to the IHEP UNK design solutions. As applied to the UNK shafts two variants of the shaft exit shielding are considered: general shielding of the shaft exit with the crane equipment location inside the shielding; local shielding of the shaft exit in a building made of conventional structures. The calculation results show that the substitution of concrete with volumetric mass of 3600 kg/m/sup 3/ for conventional concrete permits to reduce material consumption of shielding structure for all UNK over the mine shaft exits for 3500 m/sup 3/ concrete without any additional expenditures. The second variant permits alongside with general reduction of capital expenditures for constructions to disengage more than 4500 m/sup 2/ of technological areas, to reduce material consumption of the structures for more than 8000 m/sup 3/ concrete and to reduce exploitation expenditures. 3 refs.; 3 figs.; 1 tab.

9015 (JINR-D—9-87-105-Vol.2, pp 430-437) **IHEP accelerating-storage complex (Present status and development).** Ageev, A.I.; Alferov, V.N.; Balbekov, V.I. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The status of the UNK construction is described. The UNK parameters in the accelerating mode and parameters of colliding pp-beams are presented. The status of superconducting magnet development is shown. Seven ground technological buildings are being designed. The simulation of the first stage equipment is nearly completed. Vacuum systems, ring electromagnet power supply sources and injection channel magnets, first stage ring electromagnet, correcting magnets of the injection channel ring and lenses, are planned for production by the industry. The equipment models were tested in 1987 and in 1988 the serial production started. For tests of the UNK equipment the testing unit building occupying the area of 20 thousand m/sup 2/ is constructed together with the corresponding test units. The construction and assembling works are planned to be completed by 1992. 10 refs.; 11 figs.; 2 tabs.

# 44 INSTRUMENTATION

*REFER ALSO TO CITATION(S) 8604*

## 4401 Radiation Instrumentation

*REFER ALSO TO CITATION(S) 8244, 8357, 8931, 8944, 8988, 8989, 9092, 9829, 9830, 9838, 9840, 9843, 9855, 9943, 9945, 9946, 9951, 9956, 9959, 10108, 10120, 10265, 10271, 10279, 10294, 10377, 10532, 10567*

9016 **(AD-A—197515/0/XAB) $HgI_2$ near-bandgap photoluminescence structure and its relationship to nuclear detector quality.** Wong, D.; Schlesinger, T.E.; James, R.B.; Ortale, C.; Berg, L.V.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. 30p. (SAND—88-8691). NTIS, PC A03/MF A01.

Mercuric iodide is of interest because it is a high-Z material suitable for applications in nuclear radiation detection. It has an advantage over the more-commonly used silicon and germanium detectors in that, with its larger bandgap, it can be operated at room temperature. However, several problems exist in using it for fabricating nuclear detectors, an outstanding one being process control during fabrication. The low-temperature photoluminescence spectra of several mercuric iodide detectors and off-stoichiometric bulk material were characterized. Phonon energies were determined with Raman spectroscopy over a range of temperatures. In earlier work some of the near-bandgap photoluminescence features were identified as phonon replicas. After careful examination of Raman and photoluminescence data, the authors find that one or perhaps more of these features are probably due to shallow electronic levels related to native defects. Suggestions as to the relationship between photoluminescence peaks and detector quality are made.

9017 **(AD-A—197707/3/XAB) Visits by nuclear-powered warships to Australian ports; report on radiation monitoring during 1986.** (Department of Defence, Canberra (Australia)). Jan 1988. 24p. (DODA-AR—005-552). NTIS, PC A03/MF A01.

Nuclear-powered warships (NPWs) of the United States Navy visited Australia on five occasions during 1986. The Commonwealth Government requires that a radiation-monitoring program be carried out in association with such visits to detect any release of radioactivity to the port or its environs. This report represents a summary of the objectives and requirements of the NPW radiation-monitoring program, describes the implementation of the program for visits during 1986 and records the results of radiation measurements taken in the ports visited. No releases of radioactive material were detected, nor were any radiation measurements recorded in excess of background levels of ionizing radiation either during or subsequent to these visits.

9018 **(AD-A—198399/8/XAB) Shuttle-flight test of an advanced gamma-ray detection system. Final report, 1 July 1983-31 July 1987.** Rester, A.C. (Florida Univ., Gainesville (USA). Space Astronomy Lab.). 30 Jun 1988. 17p. NTIS, PC A03/MF A01.

The Gamma-Ray Advanced Detector (GRAD) is a gamma-ray detector system consisting of a large-volume, n-type germanium detector with active shielding of bismuth germanate and plastic scintillators. It was diverted from the AFP-675 program to a balloon flight over Antarctica following the Challenger Disaster and the discovery the following year of the supernova 1987A. The present report outlines activities leading to and following the decision to go to Antarctica and summarizes the basic technological results from the project.

9019 **(ANL-HEP-CP—88-58) A high resolution beam profile monitor using Bremsstrahlung.** Norem, J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 2p. (CONF-881049—41). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003965/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The development of efficient high energy linear colliders in the 1 TeV range requires final focus systems capable of producing beam spot sizes on the order of 1--20 nm, about three orders of magnitude smaller than those produced at the SLC. Although beam line designs exist which can, in principle, produce the required optics, the construction of quadrupoles with the size and precision required will be challenging. Field errors in these quads must be small and should be verified experimentally, which is difficult with existing technology. This paper describes a proposal to use bremsstrahlung from heavy targets to measure high energy beam profiles and positions with a resolution approaching a few nm. The method is also applicable to tests of other final focus systems (flat beams, plasma lenses) at lower energies. 6 refs., 3 figs., 1 tab.

9020 **(CERN-EP—88-110) High-resolution tracking with scintillating fibres.** Angelini, C.; Beusch, W.; Bloodworth, I.J.; Carney, J.N.; Crennell, D.J.; De Vincenzi, M.; Duane, A.; Fabre, J.P.; Fisher, C.M.; Flaminio, V. (European Organization for Nuclear Research, Geneva (Switzerland)). 30 Aug 1988. 18p. (CONF-8803159—1). NTIS (US Sales Only), PC A03 - OSTI. Order Number DE89003206/JAW.

From 3. topical seminar on perspectives for experimental apparatus at future high-energy machines and underground laboratories; San Miniato, Italy (7 Mar 1988).

A progress report is presented on the development of a high-resolution tracking detector based on scintillating optical glass-fibers. It is planned to use this technique in the WA84 experiment at the CERN Super Proton Synchrotron for the study of heavy-flavour production and decay. 6 refs., 10 figs., 1 tab.

9021 **(CERN-EP—88-117) Perspective of the upgraded UA2 detector at the improved CERN p{bar p} collider.** Mapelli, L. (European Organization for Nuclear Research, Geneva (Switzerland)). 6 Sep 1988. 32p. (CONF-880288—6). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89003187/JAW.

From Les Recontres de Physique; La Thuile, Italy (28 Feb 1988).

In order to fully exploit the physics potentials of the improved CERN p{bar p} Collider, the UA2 detector has been substantially upgraded. This paper reviews the motivations and the main aspects of such improvements and the physics that we intend to address with the new detector. Some of the physics perspectives discussed are compared with the results obtained at the CERN p{bar p} Collider in previous runs and with the expectations from the FNAL p{bar p} Collider. The first data taken with the new UA2 detector in November-December 1987 are also discussed briefly. 53 refs., 17 figs.

9022 **(CNIC—00083) Absolute measurement of strontium-90 and yttrium-90 radioactivity.** Lu Feng; Chen Guoan; He Xianyuan; Zhong Peiji. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). 1987. 5p. (In Chinese). (IAE—0023). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705038/JAW.

Strontium-90 and yttrium-90 is one of the important fission products. At present it is applied widely in industry because its half life is longer and its fission yield is higher. The radioactivity of the nuclide is concerned by human, because strontium-90 and Yttrium-90 is extremely poisonous for living things. The purpose of present work is to provide the standardization of strontium-90 and yttrium-90 radioactivity for the isotopic application and for the reprocessing plant. Method of determing strontium-90 and yttrium-90 radioactivity is efficiency trace technique while cobalt-60 nuclide is used as tracer. The total uncertainty of measurement is about +-1.4 percent.

9023 **(CONF-871061—4) Scintillator-fiber flow-cell radiation detector for liquid chromatography.** Rucker, T.L.; Ross, H.H.; Schweitzer, G.K. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89001935/JAW.

From 33. annual bioassay, analytical and environmental radiochemistry conference; Livermore, CA, USA (6 Oct 1987).

We have designed and developed a new type of heterogeneous flow cell which is packed with aligned scintillator-fibers instead of the solid scintillator particles currently used in heterogeneous flow cells. The fiber-scintillator detector was designed to overcome the light scattering difficulties of the conventional heterogeneous type detector. Also, we expected the fiber cell would offer better back-pressure and compound retention characteristics due to reduced surface area and the alignment of the fibers. 7 refs., 2 figs., 1 tab.

9024 **(CONF-880546—44) Development of a $^3$He/Xe gas scintillation counter to measure the $^3$He(n,p)T cross section in the intermediate energy range.** Behrens, J.W.; Wasson, O.A.; Carlson, A.D.; Ma, Hongchang. (National Bureau of Standards, Washington, DC (USA). Ionizing Radiation Div.). [1988]. Contract AI01-86ER40275. 4p. NTIS, PC A02 - OSTI. Order Number DE89004815/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

A $^3$He/Xe gas scintillation counter has been developed for measuring the neutron energy range from thermal to 3 MeV. Great effort was concentrated on improving the detector design to optimize light production and collection to improve the energy resolution which is primarily controlled by photon statistics. The detectors were tested using a $^{238}$Pu alpha-particle source, a thermal neutron beam from the NBS reactor, and the white-neutron spectrum from the NBS linac. The detector measures an energy resolution of 17% (FWHM) for the $^3$He(n,p)T reaction at 2.0 MeV which is sufficient for cross section measurement. 12 refs., 8 figs.

9025 **(CONF-881151—48) The Argonne fragment mass analyzer.** Davids, C.N.; Larson, J.D. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004278/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The Fragment Mass Analyzer (FMA) is currently under construction at the ATLAS facility. The FMA is an eight-meter long recoil mass spectrometer which will be used to separate nuclear reaction products from the primary heavy-ion beam and disperse them by A/q (mass/charge) at the focal plane. The FMA will be used in many different types of experiments. Gamma rays originating from very weak fusion-evaporation channels can be observed in coincidence with the recoil nucleus identified at the FMA focal plane. Production and decay of nuclei far from stability will be studied at the focal plane by implanting exotic recoils directly into detectors or by using a fast tape transport system. The FMA will also be used for reaction mechanism studies. A radioactive beam facility behind the focal plane is planned, which will allow beta-NMR and nuclear moment measurements to be made. The FMA will utilize the wide range of beam and intensities to be provided by the new ECR-positive ion injector also under construction at ATLAS. 8 refs., 4 figs., 1 tab.

9026 **(DESY-SR—88-03) Fast low-noise line scan X-ray detector.** Glueer, C.C.; Engelke, K.; Dix, W.R.; Graeff, W.; Kupper, W.; Stellmaschek, K.H. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik; Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Hamburger Synchrotronstrahlungslabor; Hamburg Univ. (Germany, F.R.). Kardiologische Abt.; Hamburg Univ. (Germany, F.R.). Inst. fuer Mathematik und Datenverarbeitung in der Medizin). (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik; Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Hamburger Synchrotronstrahlungslabor). May 1986. 34p. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

A fast low noise line scan detector (NIKOS) for digital radiography has been developed. It consists of an input X-ray phosphor screen that is coupled to a modified Reticon photodiode array by means of fiber optics with incorporated image intensifier. In its current version the detector can be operated with a maximum 500 Hz image acquisition rate for interlaced readout to two lines of 128

pixels each. Using a Gd/sub 2/O/sub 2/S:Tb X-ray input phosphor an afterglow of 25% in the first subsequent readout was observed. We also conducted afterglow measurements on several other powder and single crystal phosphors and the photodiode array. Using CdWO/sub 4/, the afterglow of the detector is limited by the lag of the photodiode array of 4.5%. By modifying the readout electronics the noise of the photodiode array was reduced to below 1 greylevel, corresponding to a single-to-noise ratio of 5200. The DQE of the detector ranged from 0.18 to 0.4 for typical signal levels. The sensitivity was 10% saturation per 1.9mR entrance dose. The modular design of the NIKOS detector allows for individual selection of each component to optimize performance for a given application.

9027 **(EGG-PHY—8250) Current activities in radionuclide metrology at INEL.** Helmer, R.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1988. Contract AC07-76ID01570. 49p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004877/JAW.

Within the Nuclear Sciences Unit of the Physics and Mathematics Group of EG&G Idaho at the Idaho National Engineering Laboratory, there is an on-going effort in the area of precise $\gamma$-ray spectrometry with Ge semiconductor detectors and related decay-data evaluation. Some of the current activities in these areas are described here; these include the measurement of: $\gamma$-ray energies for the decay of $^{125}$Sb, $\gamma$-ray energies for the decay of $^{154}$Eu, relative $\gamma$-emission probabilities for $^{125}$Sb, relative $\gamma$-emission probabilities for $^{154}$Eu, and $\gamma$-emission probabilities for decay of $^{181}$Hf and the evaluation of decay data for $^{94}$Nb, $^{95}$Nb, $^{153}$Eu and $^{203}$Hg. The measurements for $^{125}$Sb and $^{154}$Eu and the evaluation of decay data for the four specific radionuclides are all related to our participation in a Coordinated Research Program (CRP) of the International Atomic Energy Agency (IAEA). 53 refs., 3 figs., 17 tabs.

9028 **(FRCEA-TH—146) Application of neutron spectrometry by proton recoil proportional counters to radioprotection.** Hejira, N. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique; Toulouse-3 Univ., 31 (France)). Jul 1987. 136p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756248/JAW.

In current spectrometry, an NE213 liquid scintillator is used to analyse neutrons in 1.5 MeV - 20 MeV range and the proton recoil proportional counters are employed to explore the 20 keV to 1.5 MeV zone. We have studied two types of proton recoil counters having differents geometries. Preliminary studies of these detectors with monoenergetic neutrons are required in order to determine the experimental characteristics (efficiency, energy resolution, isotopic qualitie). In order to determine neutrons spectra from the pulse distributions recorded by the spectrometer, a computer code based on matrix analysis method has been written. A spectrometry measurement unit was also tested with an Am-Li $(n,\alpha)$ source so as to compare our results with those already published in the literature.

9029 **(GSI—88-26-Prepr.) Ray tracing of curved-crystal X-ray optics for spectroscopy on fast ion beams.** Beyer, H.F.; Liesen, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1988. 20p. Also published in Nucl. Instrum. Methods Phys. Res., Sect. A (Nov 1988) v. 272(3) p. 895-905.

A method of ray tracing is presented which allows a detailed analysis of the X-ray line profile observed with a curved-crystal spectrometer for both a stationary or a fast X-ray source. In particular, the effect of finite dimensions of crystal and source and their interplay with a finite velocity vector of the source is discussed for Johann and Johansson spectrometers. It is shown how some parameters cause distortions and shifts of the reflex and how far they can be resolved by using a two-dimensional position-sensitive X-ray detector.

9030 **(IFVE-ORI/OEA—87-177) Reduction method for processing and representation of data from multisphere Bonner spectrometer.** Zenin, G.P.; Pyt'ev, Yu.P.; Makagonov, A.V.; Shevtsov, P.V. (Moskovskij Gosudarstvennyj Univ. (USSR)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704773/JAW.

Submitted to the journal Vestn. Mosk. Univ.

The work is devoted to applying reduction method to solve the neutron spectrometry problems. A method of gaining additional information concerning spectra, based on analysing the neutron spectrum library, collected at the IHEP is proposed. Additional informationis included into the experiment scheme and the reliability of the combined model obtained is controlled. This allows one to obtain evaluation for spectrum with minimal error with the model reliability being controlled. Capabilities of the method proposed are illustrated by comparison to data, obtained using one of the modern versions of recognition program PENS-2, based on regularization method. 6 refs.; 5 figs.; 5 tabs.

9031 **(INFN-TC—86-14-A) CsI(T1) scintillators read by photodiodes as detectors of charged particles and heavy ions at intermediate energy.** Viesti, G.; Segato, G.; Prete, G.; Fornal, B.; Gramegna, F.; Yunian, L.; Fabris, D.; Nebbia, G.; Hagel, K.; Menchacha Rocha, A. (Istituto Nazionale di Fisica Nucleare, Padua (Italy); Istituto Nazionale di Fisica Nucleare, Legnaro (Italy); Texas A and M Univ., College Station (USA). Cyclotron Inst.; Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Fisica). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 15p. (In Italian). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704910/JAW.

The response of a small CsI(T1) crystal coupled to silicon photodiode to light particles and heavy ions has been investigated using proton, alpha and oxigen beams up to 25 MeV/n. The use of these detectors in nuclear physics experiments with intermediate energy heavy-ion beams is envisaged.

9032 **(INFN-TC—87-12) VME pressure regulation system for gas detectors.** Bassini, R.; Boiano, C.; Brambilla, S.; Iori, I.; Moroni, A.; Yiniji, Z. (Istituto Nazionale di Fisica Nucleare, Milan (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704911/JAW.

To regulate the gas pressure and high voltage bias in a large number of gas-filled detectors, a system has been realized based on the VME bus. The amount of gas is kept constant adjusting the pressure value as a function of the temperature. The performances of this system have been tested and compared with a commercial device. The results satisfy our requirement.

9033 **(INFN-TC—88-20) 16 element hodoscope for the detection of small angle projectile fragments in reactions induced by heavy ions at C.S. energies.** Nicotra, D.; Librizzi, F.; Rapicavoli, C. (Istituto Nazionale di Fisica Nucleare, Catania (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 8p. (In Italian). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704913/JAW.

The design of a system with plastic scintillator hodoscope for the detection of small angle fragments is dealt with here. The light transport of the scintillators (under vacuum) to the photomultipliers (in air) is obtained by means of optical fibers.

9034 **(INFO—0196) Comprehensive evaluation of the Berthold LB1200 survey meter.** Davis, M.W. (Monserco Ltd., Mississauga, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). May 1986. 78p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705120/JAW.

The performance of two Berthod LB1200 survey meters was evaluated under the influence of a range of beta and photon radi-

ation energies and environmental conditions likely to be encountered in the field. The survey meters responded satisfactorily to the range of beta particle and photon radiation energies emitted by most radioisotopes commonly used in Canada. The survey meters performed acceptably under most of the environmental conditions tested here with the exception of radiofrequency interference and electrostatic charge.

9035 (INFO—0204) **Whole-body counters in Canada.** Letourneau, C. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Aug 1986. 53p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705127/JAW.

A compilation of whole-body counting existing across Canada was prepared by AECB (Atomic Energy Control Board) staff. This work was initiated so that AECB staff and other concerned parties would have this information readily available, especially during urgent situations. This report is to be used for reference purposes only, as it makes no attempt to judge the present state of the art of whole-body counting.

9036 (INFO—0238) **Evaluation of methods to leak test sealed radiation sources.** Arbeau, N.D.; Scott, C.K. (Atlantic Nuclear Services Ltd., Fredericton, New Brunswick (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Apr 1987. 73p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705137/JAW.

The methods for the leak testing of sealed radiation sources were reviewed. One hundred and thirty-one equipment vendors were surveyed to identify commercially available leak test instruments. The equipment is summarized in tabular form by radiation type and detector type for easy reference. The radiation characteristics of the licensed sources were reviewed and summarized in a format that can be used to select the most suitable detection method. A test kit is proposed for use by inspectors when verifying a licensee's test procedures. The general elements of leak test procedures are discussed.

9037 (INFO—0239) **Evaluation of methods to calibrate radiation survey meters.** Robinson, R.C.; Arbeau, N.D. (Atlantic Nuclear Services Ltd., Fredericton, New Brunswick (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Apr 1987. 60p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705138/JAW.

Calibration requirements for radiation survey meters used in industrial radiography have been reviewed. Information obtained from a literature search, discussions with CSLD inspectors and firms performing calibrations has been considered. Based on this review a set of minimum calibration requirements was generated which, when met, will determine that the survey meter is suited for measurements described in the current AEC Regulations that apply to industrial radiography equipment. These requirements are presented in this report and may be used as guidelines for evaluating calibration methods proposed or in use in industry. 39 refs.

9038 (INIS-mf—11327, pp 1) **Neutron-optical experiments at the IBR-2 pulsed reactor.** Alexandrov, Y.A.; Kulda, J.; Machekhina, T.A.; Sedlakova, L.N.; Vrana, M.; Lukas, P.; Michalec, R.; Mikula, P.; Eichhorn, F. (Laboratory of Neutron Physics, JINR, Dubna, USSR; Nuclear Physics Institute, Rez near Prague (Czechoslovakia); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9039 (INIS-mf—11327, pp 8) **Investigation of an R-F pulsed ultrasonic transducer neutron chopper.** Hartley, J.; Fajen, O.; Berliner, R.; Werner, S.A. (Missouri Univ., Columbia (USA). Dept. of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9040 (INIS-mf—11327, pp 11) **Recent advances in X-ray and neutron interferometry.** Bonse, U. (Dortmund Univ. (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9041 (INIS-mf—11327, pp 13) **Electron interference and holography in SIOM.** Chen Jianwen; Fu Shufen; Cau Hanquing; Wang Zhijing. (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Optics and Fine Mechanics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9042 (INIS-mf—11327, pp 16) **Quantitatively measured intensity profiles of beams in the LLL-interferometer.** Dau, O. (Dortmund Univ. (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9043 (INIS-mf—11327, pp 19) **Perfect crystal neutron optics.** Eichhorn, F. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9044 (INIS-mf—11327, pp 22) **Analysis on an electron interferometer.** Fu Shufen; Ma Jian; Wang Zhijing; Cao Hanqing. (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Optics and Fine Mechanics; Baoshen Steel Works, Shanghai (China)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9045 (INIS-mf—11327, pp 51) **Neutron interferometry in India.** Rakhecha, V.C.; Wagh, A.G.; Dasannacharya, B.A. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9046 (INIS-mf—11327, pp 58) **Neutron resonators and interferometers for very low energy neutrons.** Steyerl, A. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9047 (INIS-mf—11327, pp 61) **Novel measuring methods in neutron interferometry.** Summhammer, J.; Rauch, H.; Tuppinger, D. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9048 (INIS-mf—11327, pp 71) **Diffraction-grating neutron interferometers.** Ioffe, A.I. (Leningrad Nuclear Physics Institute Gatchina, Leningrad (USSR)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9049 (INIS-SU—68, pp 492) **Possibilities of short-range particle spectrometry by high resolution planar silicon detectors.** Eremin, V.K.; Medvedev, L.S.; Strokan, N.B. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9050 (INIS-SU—68, pp 493) **Experimental installation for studying characteristics of radioactive decay of transferium nuclides.** Eremin, A.V.; Andreev, A.N.; Bogdanov, D.D. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9051 (INIS-SU—68, pp 496) **Multichannel beta spectrometer with position sensitive detector on the base of microchannel plates.** Abdumalikov, A.A.; Abdurazakov, A.A.; Blinnikov, Yu.S. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9052 (INIS-SU—68, pp 497) **Use of the position sensitive detector on the base of microchannel plates in autoradiographic method of photoimage enhancement.** Abdurazakov, A.A.; Blinnikov, Yu.S.; Pajziev, Sh.D.; Khodzhaev, M.S.; Kholmatov, A.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9053 (INIS-SU—68, pp 500) **Si(Li) detectors on base of crystals with diameters larger 100 mm.** Iskanderov, A.Sh.; Muminov, R.A.; Radzhapov, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9054 (INIS-SU—68, pp 502) **On-line control system for the magnetic beta spectrometer on base of an autonomous CAMAC controller.** Gavrilyuk, V.I.; Kirishchuk, V.I.; Stril'chuk, N.V.; Feoktistov, A.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9055 (INIS-SU—68, pp 503) **Acoustic effect and spectrometric performances of piezosemiconductor detectors.** Muminov, R.A.; Zaveryukhin, B.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9056 (INIS-SU—68, pp 504) **Photoelectrical performances of heterostructures on base of p-Al/sub x/Ga/sub 1-x/As-p-GaAs-n-GaAs for solid detecting systems.** Muminov, R.A.; Zaveryukhin, B.N.; Ismailov, Kh.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9057 (INIS-SU—68, pp 506) **Si(Li) spectrometer of electrons of internal conversion for on-line experiments.** Mezilev, K.A.; Novikov, Yu.N.; Nurmukhamedov, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9058 (INIS-SU—68, pp 507) **$\alpha$ spectra processing by means of a computer.** Rodionov, Yu.F.; Yashin, Yu.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9059 (INIS-SU—68, pp 509) **Silicon dE/dx detectors with thin inlet and outlet windows.** Dzhuraev, U.B.; Iskanderov, A.Sh.; Muminov, R.A.; Radzhapov, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9060 (INIS-SU—68, pp 510) **Low-background annihilation BGO $\gamma$ spectrometer.** Adam, I.; Blazhek, K.; Vagner, V.; Gonusek, M.; Kashevarov, V.L.; Pavlyuchenko, L.N.; Sokol, G.A.; Kharlashin, A.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9061 (INIS-SU—68, pp 511) **Studying the performance of BGO spectrometer in the energy range up to 60 MeV.** Adam, I.; Blazhek, K.; Zverev, V.G.; Kashevarov, V.L.; Sokol, G.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9062 (INIS-SU—68, pp 494) **Efficiency of detecting gamma photons with different energies by a detector on the base of microchannel plates at low temperatures.** Alpatov, V.G.; Davydov, A.V.; Konyaev, V.F.; Korotkov, M.M.; Kostina, G.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9063 (INIS-SU—68, pp 495) **Operation of gamma detectors on the base of microchannel plates at low temperatures.** Alpatov, V.G.; Davydov, A.V.; Konyaev, V.F.; Korotkov, M.M.; Kostina, G.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9064 (INIS-SU—68, pp 501) **Low-background device with silicon detectors of large area.** Iskanderov, A.Sh.; Muminov, R.A.; Radzhapov, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9065 (INIS-SU—68, pp 505) **Magnetic-exclusive detector of ionizing radiation.** Muminov, R.A.; Dobrovol'skij, V.N.; Gulamov, Sh.A.; Vorob'ev, D.L.; Zaveryukhin, B.N.; Pavlyuk, O.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9066 (INIS-SU—68, pp 508) **High-efficiency biconverter detectors of thermal neutrons.** Muminov, R.A.; Malaeva, V.T.; Oksman, M.M.; Nurbaev, K.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9067 **(IPEN-PUB—197) Calibration technique of clinical dosemeters by components.** Caldas, L.V.E.; Albuquerque, M. da P.P.; Xavier, M. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705202/JAW.

Constituted by ionization chambers (timble and superficial types) connected to special electrometers, the clinical dosemeters are normally calibrated in /sup 60/Co radiation fields as whole systems in relation to a secondary standard. In order to allow the users to send only one of the pieces for recalibration, a very useful procedure for those who own several ionization chambers and only one electrometer, a technique of calibration by components was developed in the present work. A standard capacitor of 1000 pF and a special standard current source, consisting of an ionization chamber and a /sup 90/Sr source, were used. The obtained results showed a difference lower than 0,4% between them. In relation to the total calibration method, the calibration presented differences lower than 0,7% for several clinical dosemeters tested.

9068 **(IPEN-PUB—200) Dosimetric MgB/sub 4/O/sub 7/:RE and CaB/sub 4/O/sub 7/:RE Obtention.** Fernandes Filho, O.O.; Campos, L.L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 20p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705204/JAW.

The Thermoluminescent Dosimetry (TLD) has been widely used in personnel and environmental monitoring. Among the several materials employed for this purposes, those which have attracted higher recently interest are the Magnesium and Calcium Tetraborates activated with Rare Earth (RE) elements. This work describes the preliminary results on the development of a proper method for the preparation of this materials, presenting the TL glow curves, variation of TL-signal as a function of activator concentration, temperature and time of sintering.

9069 (JINR-D—9-87-105-Vol.2, pp 355-362) **Status and prospects of development of metrological radiation measurements on the Serpukhov proton synchrotron.** Golovachik, V.T.; Lebedev, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The status and prospects of the development of metrological radiation control at accelerators are analyzed using as an example the Serpukhov proton synchrotron. Basic information on radiation dose characteristics and sensitivity functions of the detectors used, the system of mixed radiation detectors and the system of ionizing radiation reference fields, including accelerator radiation fields are the basis of metrological radiation measurements at the Serpukhov proton synchrotron. 16 refs.; 4 figs.; 3 tabs.

9070 (JINR-D—9-87-105-Vol.2, pp 385-388) **Using tissue-equivalent low-pressure proportional counter for fast neutron spectrometry.** Alekseev, A.G.; Golovachik, V.T.; Sannikov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Ionizing radiation reference radiometers (RR), which permit to transmit the unit of equivalent dose to operating monitors during their calibration, are the most important part of metrological radiation control(MRC) on accelerators. Spectrometer of linear energy transfer (LET) on the basis of tissue-equivalent (TE) spherical proportional low-pressure counter as a MRC model of equivalent and absorbed dose of mixed radiation can be used. An attempt is made to combine the method of LET-spectrometry with the measurement of neutron energy spectra using one detector, which permits to reduce the systematic error, caused by the differences in energy dependences of LET-spectrometer sensitivity and the maximum equivalent dose (MED) of neutrons. It is shown that both neutron energy spectrum and LET spectrum can be restored on the basis of LET-spectrometer apparatus spectrum, using monoenergetic neutron linear energy spectra as a sensitivity matrix in the detector sensitive volume. The method suggested permits to decrease the ambiguity when passing from the results obtained to MED and not using phanthom in the measurements. Elimination of the given systematic error is important, since LET-spectrometer is intended to be used as a MRC model to transmit the unit of equivalent dose to the operating monitors in reference fields of photon and neutron radiation. 12 refs.; 3 figs.; 1 tab.

9071 **(KEK—87-24) Proceedings of the workshop on 12 GeV PS experiments.** Kumagai, N.; Chiba, J.; Tsuru, T.; Yoshimura, Y.; Sasao, N. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1988. 164p. (In Japanese). (CONF-8710423—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756069/JAW.

From Workshop on 12 GeV PS experiments; Tsukuba, Japan (12 Oct 1987).

It is considered that in the physics using the KEK (National Laboratory for High Energy Physics) PS, the experiment using high intensity proton beam such as the experiment on nuclei with kaons and the research on rare decay becomes important in future, therefore, the improvement of accelerators and the construction of new beam channels and a new laboratory have been investigated. The request of budget has been made according to this plan, and it was approved in the revised budget for fiscal year 1987. It was decided to construct a new laboratory in the existing bubble chamber beam line, and move a part of beam lines to there. A first plan was made by a KEK group, and based on it, it becomes necessary to work out the best plan to be executed, considering the experimental plan and schedule of PS users. Also the plan of using the existing laboratories after the move of beam channels must be examined, therefore, the workshop was held on October 12 and 13, 1987, and more than 50 people took part in the discussion. In this book, the reports presented at that time are collected. (Kako, I.).

9072 **(KEK—87-27) Proceedings of the second data acquisition system workshop.** Ohska, T.K. (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1988. 224p. (In Japanese). (CONF-8607376—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88756070/JAW.

From 2. data acquisition system workshop; Tsukuba, Japan (18 Jul 1986).

The second data acquisition system workshop was held on July 18 and 19, 1986 at the National Laboratory for High Energy

Physics (KEK). The organizers had one thing in mind when this workshop was planned. It was wanted to make a record of mistakes in designing and building the electronic system. The time when this workshop was held was just before the completion of the TRISTAN detectors when everyone was very busy. Brilliant achievements have been published every year in the world, but the hard earned experience on what should not be done does not appear on publication. To record it while it is still hot was the basic motivation of this workshop. More than 100 people attended the workshop, and some speakers did excellently what the organizers hoped to do, but some talked on their great achievements only. The organizers are very thankful to everybody who helped before, during and after the workshop. If possible, it should be asked all speakers to hand in their write-ups on the day of the workshop. Actually, the last write-up was received almost one year late, and the publication of this report delayed. In this book, those write-ups are collected. (Kako, I.).

9073 **(LAL-RT—87-10) Active filters study for electronic circuit associated at the lecture of signals coming from detectors with high particle rates.** Martin, G. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-11 Univ., 91 - Orsay (France)). Sep 1987. 154p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756259/JAW.

In the case of detectors with high particle rates, the read out electronics has to be fast. The overall response of the chain to the detector signal has to be made short by using appropriate filtering. Hence, shortening filters are used for the detector signal tail, for the preamplifier integration time constant and for the transmission cable tail when used with fast signals. For exponential waveform shortening, the filter synthesis is easy: the signal pole is cancelled by the zero of the filter circuit response and replaced by a new pole. The filter is called a pole-zero. For a signal with a non exponential tail, there is no simple way to accomplish the filter synthesis. In this case, the same pole-zero filters are used, but the synthesis is done by using an approximation for the signal with: a fast component by a Dirac function and a slow component by an exponential function. We are able in this case to determine the characteristics of the filter as a function of the desired shortening, which depends on the gaussian filter width desired for the overall response.

9074 **(N—88-29136) Large area nuclear particle detectors using ET materials.** (Quantex Corp., Rockville, MD (USA)). Aug 1987. 17p. (NASA-CR—180777; NAS—1.26:180777). NTIS, PC A03/MF A01.

The purpose of this SBIR Phase 1 feasibility effort was to demonstrate the usefulness of Quantex electron-trapping (ET) materials for spatial detection of nuclear particles over large areas. This demonstration entailed evaluating the prompt visible scintillation as nuclear particles impinged on films of ET materials, and subsequently detecting the nuclear particle impingement information pattern stored in the ET material, by means of the visible-wavelength luminescence produced by near-infrared interrogation. Readily useful levels of scintillation and luminescence outputs are demonstrated.

9075 **(OEFZS—4461) Calibration of a HP-Germanium detector for rapid in-situ determination of environmental radioactivity.** Nemeth, I.; Zombori, P.; Andrasi, A.; Lovranich, E.; Urbanich, E.; Steger, F. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Strahlenschutz). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Aug 1988. 42p. (ST—160/88). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705208/JAW.

The method of in situ gamma-spectrometric determination of environmental radioactivity was introduced in the environmental monitoring system of the research centre at Seibersdorf (Austria). The semiconductor detector (HP-Ge) was calibrated and tested for field measurements of natural and artificial radionuclides distributed on/in the soil. The method and its application is discussed, the way of calibration and some of the model calculations are presented as well as results of intercomparison measurements with the Health Physics Department of the Central Research Institute for Physics in Budapest. 19 refs., 10 figs., 14 tabs.

9076 **(OEFZS—4472) Intercomparison of gamma-spectrometric activity measurements in whey and hay, 1987, in Austria.** Lovranich, E.; Steger, F.; Karg, V.; Henrich, E. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Strahlenschutz; Bundesanstalt fuer Lebensmitteluntersuchung und Forschung Wien). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Oct 1988. 70p. (In German). (ST—162/88). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705212/JAW.

After the Chernobyl-disaster a comparison for gammaspectrometric evaluations in Austria with wheypowder and hay, contaminated after Chernobyl was organized. Results are presented and data such as comparability, reproducibility and others were calculated. 6 refs., 18 figs., 22 tabs.

9077 **(PNL-SA—16036) Spatial patterns of ionization in charged-particle tracks.** Toburen, L.H.; Metting, N.F.; Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 14p. (CONF-881151—47). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004359/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The physical structure of charged-particle tracks plays an important role in determining the response of a stopping material to the absorption of energy following irradiation by charged particles and neutrons. For biological systems, and for microelectronic circuits, the response is sensitive to the energy deposited in submicron-size volume elements. Because of the stochastic nature of energy deposition in and near charged particle tracks, there may be wide variations in the actual quantities of energy deposited in critical volume elements. Since direct measurements of energy deposition in condensed material (solids or liquids) are technologically infeasible, the effects of charged-particle track structure are usually estimated from one of several model calculations; the most commonly used are homogeneous track structure models. Recent interest in the radiation biology of high Linear-Energy-Transfer (LET) radiation has spurred interest in testing these model descriptions of the structure of high-energy heavy-ion tracks. As one means of providing such tests, experiments were recently conducted at the GSI-Darmstadt, UNILAC accelerator, to measure energy deposition in small volumes as a function of the radial distance from the path of fast, heavy ions. These measurements, conducted in collaboration with research groups of Dr. G. Kraft at GSI and Prof. Schmidt-Boecking of the University of Frankfurt, were made for simulated tissue volumes 0.5 and 1.0 μm in diameter, located from 0–10 μm from the path of Ge ions having energies from 13.0–17.2-MeV/amu. Excellent agreement was observed between model calculations and measured dose distributions for radial distances up to a few micrometers in simulated tissue. 6 refs., 4 figs.

9078 **(PNL-SA—16111) High dose calibrations at the Pacific Northwest Laboratory.** McDonald, J.C.; Fox, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 6p. (CONF-881151—43). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004358/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The need is increasing for both high radiation exposures and calibration measurements that provide traceability of such exposures to national standards. The applications of high exposures include: electronic component damage studies, sterilization of medical products and food irradiation. Accurate high exposure measurements are difficult to obtain and cannot, in general, be carried out with a single dose measurement system or technique because of the wide range of doses and the variety of materials involved. This paper describes the dosimetric measurement and calibration techniques used at the Pacific Northwest Laboratory (PNL) that make use of radiochromic dye films, thermoluminescent dosimeters (TLDs), ionization chambers, and calorimetric dosimeters. The

methods used to demonstrate the consistency of PNL calibrations with national standards will also be discussed. 4 refs.

9079 **(RFP—4165) Tank evaluation system shielded annular tank application.** Freier, D.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 4 Oct 1988. Contract AC04-76DP03533. 30p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004430/JAW.

TEST (Tank Evaluation SysTem) is a research project utilizing neutron interrogation techniques to analyze the content of nuclear poisons and moderators in tank shielding. TEST experiments were performed on an experimental SAT (Shielded Annular Tank) at the Rocky Flats Plant. The purpose of these experiments was threefold: (1) to assess TEST application to SATs, (2) to determine if Nuclear Safety inspection criteria could be met, and (3) to perform a preliminary calibration of TEST for SATs. Several experiments were performed, including measurements of 11 tank shielding configurations, source-simulated holdup experiments, analysis of three detector modes, resolution studies, and TEST scanner geometry experiments. 1 ref., 21 figs., 4 tabs.

9080 **(SLAC—332) Cerenkov ring imaging and spectroscopy of charged KSTAR interactions at 11 GeV/c.** Bird, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 239p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004501/JAW.

The physics and technology of this new Cerenkov detector are discussed, including materials studies, construction techniques, and resolution measurements. Sources of resolution error are individually identified and measured where possible. The results of all studied indicate that the measurement resolution is understood. This work has led to the adoption of a large scale ring imaging detector as part of a new high energy physics spectrometer, the SLD, at the Stanford Linear Accelerator Center. Results from an amplitude analysis of strange meson final states in K/sup {minus}/p → {ovr K{sub 0}}$\pi$/sup {minus}/p interactions are presented. The data derive from a 4 event/nb exposure of the LASS (large Aperture Superconducting Solenoid) spectrometer to an 11 GeV/c K/sup {minus}/ beam. The data sample consists of {approximately}100,000 vents distributed over the Dalitz plot of the channel. The process is observed to be dominated by the production and decay of natural spin-parity (J/sup P/ = 1/sup {minus}/,2$^+$,3/sup {minus}/,{hor←ellipsis}) strange meson states. The data can be understood in terms of a simple model in which the resonant {ovr K*{sup -}} are produced predominantly via natural parity exchange in the t channel. The leading K*(890), $K_2$*(1430), and K*(1780) resonances are clearly observed and measured, and the underlying spectroscopy is also extracted. Indications of higher mass resonance production are also shown. The observed properties of these states are used to confront current models of quark spectroscopy in strange meson systems. 94 refs., 96 figs., 23 tabs.

9081 **(SLAC-PUB—4772) Radiation aging studies of $CO_2$ hydrocarbon mixtures for the SLD drift chamber.** Venuti, J.P.; Chadwick, G.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 6p. (CONF-881103—23). NTIS, PC A02/MF A01 - OSTI. Order Number DE89005011/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

The SLD drift chamber requires a 'slow' drifting gas and low diffusion to allow wave form digitization. $CO_2$ provides this but requires an admixture of a quencher to provide more gain. A test chamber with an 8 sense wire cell, such as will appear in the final chamber, was exposed to an x-ray tube while containing a variety of binary admixtures of $Co_2$: 8% isobutane, 8% ethane, and 2% isopropanol. It was determined that adding small fractions of water (≦0.66%) or isopropanol (1--2%) to the $Co_2$: 8% ethane, or 8% isobutane extended the useful life of the chamber so that integrated charge collections of {approximately}1 C/cm are permissible. Results and discussions are presented. 10 refs., 7 figs., 1 tab.

9082 **(SLAC-PUB—4786) A status report on the SLD data acquisition system.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 6p. (CONF-881103—22). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004965/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

The basic design of the SLD data acquisition system and its present status are reviewed. Aspects of the design that take particular advantage of the relatively low e$^+$ e/sup {minus}/ cross section and the low beam crossing rate of a linear collider are explained. 14 refs., 8 figs.

9083 **(TRI-PP—88-79) Tensor polarimeters.** Stevenson, N.R. (Saskatchewan Univ., Saskatoon (Canada). Dept. of Physics). 1988. 8p. (CONF-880983—25). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE89005052/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

Tensor polarimeters used to spin-analyze recoiling deuterons from various reactions are becoming more common. Here we discuss the basic elements of tensor polarimeters, their uses, and the various types of devices. In particular, we focus on those employing the $^3$He({rvec d},p)$^4$He reaction including the latest high efficiency liquid $^3$He device capable of simultaneously measuring all vector and tensor spin components. Finally we will examine a candidate reaction for use in high energy tensor polarimeters. 21 refs., 10 figs.

9084 **(UCID—21548) Using the transportable, computer-operated, liquid-scintillator fast-neutron spectrometer system.** Thorngate, J.H. (Lawrence Livermore National Lab., CA (USA)). 1 Nov 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004981/JAW.

When a detailed energy spectrum is needed for radiation-protection measurements from approximately 1 MeV up to several tens of MeV, organic-liquid scintillators make good neutron spectrometers. However, such a spectrometer requires a sophisticated electronics system and a computer to reduce the spectrum from the recorded data. Recently, we added a Nuclear Instrument Module (NIM) multichannel analyzer and a lap-top computer to the NIM electronics we have used for several years. The result is a transportable fast-neutron spectrometer system. The computer was programmed to guide the user through setting up the system, calibrating the spectrometer, measuring the spectrum, and reducing the data. Measurements can be made over three energy ranges, 0.6--2 MeV, 1.1--8 MeV, or 1.6--16 MeV, with the spectrum presented in 0.1-MeV increments. Results can be stored on a disk, presented in a table, and shown in graphical form. 5 refs., 51 figs.

9085 **Four-frame gated optical imager with 120-ps resolution.** Young, P.E.; Hares, J.D.; Kilkenny, J.D.; Phillion, D.W.; Campbell, E.M. (Lawrence Livermore National Lab., PO Box 5508, Livermore, CA (US)). pp 222-227 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

In this paper, the authors describe the operation and applications of a commercially available framing camera capable of four separate two-dimensional images with each frame having a 120-ps gate width. The time separation between frames can be selected arbitrarily. Fast gating of a single frame is accomplished by using a wafer image intensifier tube in which the cathode is capacitively coupled to an external electrode placed outside of the input window of the tube. This electrode is then pulsed relative to the microchannel plate by a narrow (120 ps), high-voltage pulse. The transmission of the tube as a function of time has been verified using a laser-diode pulser and is approximately Gaussian with a FWHM of 120 ps. Multiple frames are obtained by using multiple gated tubes which can then share a single bias supply and pulser with relative gate times selected by the cable lengths between the tubes and the pulser. A beamsplitter system has been constructed

which produces a separate image for each tube from a single scene. In the present system, the tubes use S-20 photocathodes with an 18 diameter and quartz input windows. Spatial resolution is unchanged between d.c. and fast gated operations and has been measured to 10 1p/mm. Applications to time-dependent behavior are presented.

9086 **A focussed MCP image intensifier tube for high speed gating.** Vine, B.; Yates, G. (EG and G Energy Measurements, Inc., CRT Operations, 19 Wheeling Ave., Woburn, MA (US)). pp 190-192 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

This tube is aimed at shuttering speeds faster than 200 picoseconds, with required electrical gate pulse less than 80 volts. Similar tubes were described in a 1984 paper at this meeting. One new feature is the use of a microchannel plate (MCP) to provide high and adjustable signal gain. This tube, in comparison with proximity-focussed tubes, conserves resolution by using an electrostatic focus lens. Also new is the use of transfer photocathode technique to eliminate stray emission from the gate mesh. Measured performance: Gating speed, Gain, On-Off signal ratio is presented. Tube construction and the transfer photocathode technique is discussed. The noise which shows up in high-gain imaging systems is discussed.

## 4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

*REFER ALSO TO CITATION(S) 9081*

9087 **(AD-A—197216/5/XAB) Total-dose response of silicon-on-insulator (soi) metal-oxide- semiconductor field-effect transistor's (mosfet's). Master's thesis.** Biwer, M.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Jun 1988. 80p. (AFIT/CI/NR—88-167). NTIS, PC A05/MF A01.

Total-dose response of both NMOS and PMOS FET's fabricated on SIMOX and ZMR substrates was studied. Two types of back-channel leakage currents were identified for the SIMOX devices. A back channel leakage due to MOSFET action uses the substrate bias as the gate bias. The other component is due to soft reverse characteristics of the body-drain junction. The back-channel leakage due to MOSFET action varies with the substrate bias and thus varies with irradiation due to threshold-voltage shift. The soft reverse current is a function of drain-body voltage and hence varies with substrate bias and irradiation. The threshold-voltage, I-V characteristics, and subthreshold currents of both front and back channels as a function of total dose were obtained.

9088 **(AD-A—197621/6/XAB) Radiation effects in low-pressure reoxidized nitrided oxide gate dielectrics.** Dunn, G.J.; Jayaraman, R.; Yang, W.; Sodini, C.G. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 16 May 1988. 4p. (JA—6016A). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 52, No. 20, 1713-1715(16 May 1988).

Nitridation of the gate oxide is known to improve the radiation resistance of metal-oxide-semiconductor devices on silicon. However, it has generally been found that high-temperature, long-time anneals are required to produce the hardest dielectrics. Results are reported of 1-5 Mrad (Si) total dose radiation testing of thin-gate oxides that have received relatively light nitridations, followed by a reoxidation step. These devices exhibit substantially reduced fixed charge and interface-state buildup compared with oxide, and appear to be harder than the more heavily nitrided oxides previously reported.

9089 **(AERE-R—12779) Effects of total dose on the SEU sensitivity of CMOS static RAMS. Final report.** Sanderson, T.K.; Mapper, D.; Stephen, J.H.; Farren, J. (UKAEA Harwell Lab.). Jul 1987. 77p. (ESA-CR(P)—2551; ETN—88-92774). NTIS, PC A05/MF A01; Her Majesty's Stationary Office, P.O. Box 276, London SW8 5DT, United Kingdom 5 pounds.

The effects of accumulated total dose on single event upset (SEU) sensitivity of 4Kx1 CMOS static random access memories (RAMs) were studied by making SEU measurements using the fission particles produced by a Cf252 source, while total dose was accumulated by a continuous low dose rate irradiation with Co60 gamma rays, lasting 8 months. The saturation cross section for SEU in the 4Kx1 CMOS static RAMs shows no significant change with increasing total dose from a low dose-rate Co60 source. However, in even more complex devices possessing a critical charge that is already small, any process such as total dose accumulation, that greatly reduces this critical charge, is important. In this situation, the large fluxes in space of low atomic number particles such as helium ions, start to contribute to the upset rate. Changes in the switching characteristics of a MOS static RAM cell can occur, associated with shifts in the threshold voltages of the n and p channel MOSFETs in the circuit.

9090 **(INIS-mf—11864) Integration of the Exo-EMP in a zero-loss line above an infinitely conductive metal plate.** Graf, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Euskirchen (Germany, F.R.). Inst. fuer Naturwissenschaftlich-Technische Trendanalysen). Apr 1987. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756188/JAW.

Fraunhofer-Institut fuer Naturwissenschaftlich-Technische Trendanalysen (INT). Bericht.; no. 127.

A coupling model is used for the estimation of the disturbance variables produced by the NEMP over large well-conducting implement or system carriers such as ships, airplanes or tanks. The calculation of the coupling can apparently be applied also to quick alternations of the coupling fields with the help of the line theory. During this, the time of the increase of the Exo-EMP amounts to some nanoseconds.

## 4403 Miscellaneous Instruments

*REFER ALSO TO CITATION(S) 7790, 7849, 7963, 8436, 8744, 8758, 8770, 9112, 9143, 10132, 10227*

9091 **(CONF-890105—1) Motor current signature analysis: A potential diagnostic for air conditioners.** Miller, W.A.; Haynes, H.D.; Griffin, F.P.; Levins, W.P.; Karnitz, M.A. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE88009710/JAW.

From ASHRAE winter symposium; Chicago, IL, USA (28 Jan 1989).

Recent advancements in modern electronics have made it possible to collect the various "transient noise" signals which are present on electric power lines of motor-driven equipment while using a simple non-intrusive clamp-on inductive pickup. Electronic filters are used to analyze the noise signal with an on-the-spot, real-time analysis. An exploratory study, conducted at ORNL, examined the potential for using the motor current signature on heat pumps and air conditioners as a diagnostic tool. Preliminary results show that there is some correlation between the motor current signature and the performance of a heat pump. However, the tests and associated analysis were limited, and additional research is needed to determine the full potential of motor current signature analysis (MCSA).

9092 **(CONF-8810182—7) GLAD: The IPNS Glass, Liquid, and Amorphous Materials Diffractometer.** Crawford, R.K.; Price, D.L.; Haumann, J.R.; Kleb, R.; Montague, D.G.; Carpenter, J.M.; Susman, S.; Dejus, R.J. (Argonne National Lab., IL (USA)). 29 Sep 1988. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004273/JAW.

From International collaboration on advanced neutron sources (ICANS); Los Alamos, NM, USA (3 Oct 1988).

This paper discusses the instrument GLAD (Glass, Liquid, and Amorphous Materials Diffractometer) which has been designed to meet these criteria and is now being built at IPNS. This instrument involves the use of relatively short-wavelength neutrons and a sophisticated neutron detection and acquisition system. A preliminary, simplified version of the instrument has been constructed while the final version is still under design, in order to develop the data acquisition and analysis techniques and to develop methods for collection of data with adequate quality (low background) at short wavelengths. This paper will briefly outline the final instrument envisioned and its calculated performance, but will focus mostly on the details of the detection/acquisition system and the calibration and data collection procedures which have been developed. The brief operating experience which has been gained to date with the preliminary instrument version will also be summarized. 6 refs., 12 figs.

9093 **(DOE/ER/13347—2) Hadamard transform spectrometry: A new analytical technique: Progress report, March 15, 1988--March 14, 1989.** Fateley, W.G. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). 1988. Contract FG02-85ER13347. 19p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004687/JAW.

The following four projects were initiated during the first year of this three year program: construction of a stationary interferometer for possible use in the Hadamard transform Raman HPLC experiment; construction of a dispersive Hadamard transform spectrometer with concave holographic gratings for possible application as a HPLC detector; investigation of new polymer-dispersed liquid crystal films as efficient optical shutters for making improved Hadamard encoding masks; and improvement of the software necessary to recover a spectrum from the Hadamard encoded data. This paper covers these topics. 5 refs., 3 figs.

9094 (INIS-mf—11327, pp 14) **Ultra-high sensitivity accelerometers and gyroscopes using neutral atom matter-wave interferometry.** Clauser, J.F. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

9095 **(LA-UR—88-3866) Sensing applications of rare-earth doped luminescent materials.** Allison, S.W.; Cates, M.R.; Simpson, M.L.; Noel, B.W.; Turley, D.; Gillies, G.T. (Oak Ridge National Lab., TN (USA); Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36;AC05-84OR21400. 12p. (CONF-8811114—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003580/JAW.

From ICALEO conference; Sunnyvale, CA, USA (1 Nov 1988).

We are developing sensing techniques using phosphors and luminescing crystals. While their use in temperature sensing is becoming well known, there exists the potential to exploit them for other diagnostics. Examples are stress/strain, heat flux, skin friction, pressure, laser-beam profiling, aerodynamic flow, and radiation. We describe our recent results in these areas. 16 refs., 7 figs.

9096 **(LBL—26187) X-ray holographic microscopy: Improved images of zymogen granules.** Jacobsen, C.; Howells, M.; Kirz, J.; McQuaid, K.; Rothman, S. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098;AC02-76CH00016. 11p. (CONF-880904—6). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004783/JAW.

From 4. topical meeting on short wavelength coherent radiation: generation and applications; Cape Cod, MA, USA (26 Sep 1988).

Soft x-ray holography has long been considered as a technique for x-ray microscopy. It has been only recently, however, that sub-micron resolution has been obtained in x-ray holography. This paper will concentrate on recent progress we have made in obtaining reconstructed images of improved quality. 15 refs., 6 figs.

9097 **(N—88-30100) Development of a unit cell for a Ge:Ga detector array. Final contractor report, June 1984-September 1986.** (Aerojet ElectroSystems Co., Azusa, CA (USA)). Aug 1988. 93p. (NASA-CR—177445; NAS—1.26:177445). NTIS, PC A05/MF A01.

Two modules of gallium-doped germanium (Ge:Ga) infrared detectors with integrated multiplexing readouts and supporting drive electronics were designed and tested. This development investigated the feasibility of producing two-dimensional Ge:Ga arrays by stacking linear modules in a housing capable of providing uniaxial stress for enhanced long-wavelength response. Each module includes 8 detectors (1x1x2 mm) mounted to a sapphire board. The element spacing is 12 microns. The back faces of the detector elements are beveled with an 18 deg angle, which was proved to significantly enhance optical absorption. Each module includes a different silicon metal-oxide semiconductor field effect transistor (MOSFET) readout. The first circuit was built from discrete MOSFET components; the second incorporated devices taken from low-temperature integrated circuit multiplexers. The latter circuit exhibited much lower stray capacitance and improved stability. Using these switched-FET circuits, it was demonstrated that burst readout, with multiplexer active only during the readout period, could successfully be implemented at approximately 3.5 K.

9098 **(N—89-10264) Compact imaging spectrometer for induced emissions. Final technical report, 31 March 1986-1 February 1988.** Torr, D.G. (Alabama Univ., Huntsville (USA)). Sep 1988. 20p. (NASA-CR—183187; NAS—1.26:183187). NTIS, PC A03/MF A01.

On the basis of spectral measurements made from the Space Shuttle and on models of the possible Space Station external environment, it appears likely that, even at the planned altitudes of Space Station, photon emissions will be induced. These emissions will occur to some degree throughout the ultraviolet-visible-infrared spectrum. The emissions arise from a combination of processes including gas phase collisions between relatively energetic ambient and surface emitted or re-emitted atoms or molecules, where the surface raises some species to excited energy states. At the present time it is not possible to model these processes or the anticipated intensity levels with any accuracy, as a number of fundamental parameters needed for such calculations are still poorly known or unknown. However, it is possible that certain spectral line and band features will exceed the desired goal that concomitant emissions not exceed the natural zodiacal background. Also, in the near infrared and infrared, it appears that this level will be exceeded to a significant degree. Therefore it will be necessary to monitor emission levels in the vicinity of Space Station, both in order to establish the levels and to better model the environment. A small spectrometer is briefly described which is suitable for monitoring the spectrum from 1200 A to less than or equal to 12,000 A. The instrument uses focal plane array detectors to image this full spectral range simultaneously. The spectral resolution is 4 to 12 A, depending on the portion of the wavelength range.

9099 **(PNL—6742) Test of dip cup instrumentation.** Brenden, B.B. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004423/JAW.

Instrumentation has been developed which will measure the alumina content of cryolite baths based upon the detection of a thermal arrest in the cooling curve when a small sample is pulled from the bath using a graphite cup. Detection of the temperature at which thermal arrest occurs is automatic, and an alumina content is automatically calculated and displayed. Recent measurements at a production plant indicate a standard error of 0.38% or less in the determination of alumina content based upon a set of 9 measure-

ments. The time required for a single measurement is less than 5 minutes. No further development of the technique of instrumentation is planned at the present time. 1 ref., 2 figs., 4 tabs.

9100 **(SAND—88-1325) AFTI/SITAN [Advanced Fighter Technology Integration/Sandia Inertial Terrain-Aided Navigation] final report.** Fellerhoff, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 250p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004000/JAW.

Sandia Inertial Terrain-Aided Navigation (SITAN) provides continuous position fixes to an inertial navigation system (INS) by real-time comparison of radar altimeter ground clearance measurements with stored digital terrain elevation data (DTED). This is accomplished by using an extended Kalman filter algorithm to estimate the errors in the reference trajectory provided by an INS. In this report, Sandia National Laboratories documents the results of a reimbursable effort funded by the Air Force Wright Aeronautical Laboratories (AFWAL) Avionics Laboratory to flight test SITAN as implemented onboard the Advanced Fighter Technology Integration (AFTI)F-16. 5 refs., 101 figs., 1 tab.

9101 **(UCRL—99954) Precision transfer function measurements of integrated optical modulators.** Lowry, M.; Lancaster, G.; Peterson, R.T.; McWright, G.; Nelson, D.; Kidd, B. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 7p. (CONF-8809105—11). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004021/JAW.

From SPIE O-E Lase: international symposium and exhibition on fiber optics, optoelectronics and laser applications; Boston, MA, USA (6 Sep 1988).

We present transfer function (TF) data from a Crystal Technology, Inc. 2 x 2 switch modulator. The data was obtained using an in-house designed and built automated measurement system that uses pulsed optical illumination at 840 nm and pulsed electrical modulation input, to simulate our actual operating conditions for the device. The precision of the TF system electronics is found to be better than 1% over most of the measurement range and approaching 0.1% at the midrange of the signals. The reproducibility of the transfer functions themselves was found to be better than 2.0%. The effects of photorefractive damage on the device transfer function were studied. For optical doses of approximately 12 mJ (device output) at 840 nm the photorefractively induced changes in the TF were less than 10%. The effects of temperature on the transfer function were studied over a temperature range of 23 C to 45 C and found to be quite significant for one of three devices measured. For two others the temperature effects were nearly negligible. 4 refs., 9 figs.

9102 **Rapid, differential microthermometry using Zeeman interferometry.** Johnston, R.G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **54**: No. 3, 289-291(16 Jan 1989).

Zeeman interferometry, based on the two-frequency Zeeman effect laser, can be used for simple, noncontact differential thermometry. The thermometry is differential in both space and time. Small (0.73 μl-script ) laser-heated volumes were monitored with a Zeeman interferometer. Heating rates varied over six orders of magnitude from 180 μK/s to 330 K/s. Temporal resolution was 10 μs. Measured temperatures and measured rates of heating were compared with theory for slowly and rapidly heated samples, respectively.

9103 **Speckle processing method for synthetic-aperture-radar phase correction.** Eichel, P.H.; Ghiglia, D.C.; Jakowatz C. Jr. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **14**: No. 1, 1-3(1 Jan 1989).

Uncompensated phase errors present in synthetic-aperture-radar data can have a disastrous effect on reconstructed image quality. We present a new iterative algorithm that holds promise of being a robust estimator and corrector for arbitrary phase errors. Our algorithm is similar in many respects to speckle processing methods currently used in optical astronomy. We demonstrate its ability to focus scenes containing large amounts of phase error regardless of the phase-error structure or its source. The algorithm works extremely well in both high and low signal-to-clutter conditions without human intervention.

9104 **Dual optimality of the phase-only filter.** Dickey, F.M.; Romero, L.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **14**: No. 1, 4-5(1 Jan 1989).

A measure of the peak-to-sidelobe performance for correlation filters is defined. The phase-only filter is then shown to be optimum with respect to the peak-to-sidelobe criterion. The phase-only filter has been previously shown to give optimum signal-to-noise performance. Thus, under the assumption of a unit modulus phase device, optimum peak-to-sidelobe and signal-to-noise performance can be obtained simultaneously.

9105 **Wavelength-dependent studies of optical second-harmonic generation from Fe—18Cr—3Mo(110) in ultrahigh vacuum.** Hamilton, J.C.; Anderson, R.J. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 100-102(Jan 1989).

This paper describes second harmonic generation which is a promising surface diagnostic that will alloys surface studies under ambient pressure and studies of liquid-solid and solid-solid interfaces. The structure and composition of the interface can be determined by this method. This metho d is demonstrated for Fe-18Cr-3Mo (100) in ultrahigh vacuum. (AIP)

9106 **Use of predetection mixing of intensity modulated optical beams.** Scott, M.; Garcia, P. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Applied Optics;* **27**: No. 24, 5119-5122(15 Dec 1988).

Predetection mixing of the intensity modulation on optical beams is shown to have performance advantages in certain laser radar applications. The method allows detection of signals with high frequency intensity modulation using a low frequency sensor. The method can lead to a signal-to-noise ratio improvement compared to a system using a high frequency sensor. The technique is demonstrated by using a sensor with a 5-kHz cutoff frequency to receive a laser beam intensity modulated at 4 MHz.

9107 **Dead-time compensation for a logarithmic display rate meter.** Larson, J.A.; Krueger, F.P. (to Dept. of Energy, Washington, DC). US Patent 4,772,793. 20 Sep 1988. Filed date 5 Oct 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a compensation circuit for an event detector that is used to count occurrences of random events occurring at variable rates, the event detector having a characteristic live time during which a single event is detectable and having an actual dead time after the detection of an event during which the detector is disabled from detecting events, the compensation circuit compensating for the occurrence of events during the dead time. The compensation circuit consists of: means for generating a dead-time pulse of predetermined duration at least equal to the actual dead time, the dead time pulse initiated by detection of the occurrence of one of the random events; means for generating a live-time pulse corresponding to a time interval between the end of a dead-time pulse and the beginning of a following period of dead-time pulse; means for responsive to the means for generating a live-time pulse for averaging live-time pulses over time; means responsive to the means for generating a dead-time pulse for averaging dead-time pulses over time; means for obtaining a first voltage that is an analog of the logarithm of the average live-time pulses; means for obtaining a second voltage that is an analog of the logarithm of the averaged dead-time pulses time; and means for subtracting the first voltage from the second voltage to obtain a third voltage that is an analog of a count rate that is corrected for the occurrence of undetected events occurring during dead time.

9108 **Magnetic sample holder for Raman spectrometry.** Freeman, R.D.; Hammaker, R.M.; Meloan, C.E.; Fateley, W.G. (Kansas State University, Department of Chemistry, Willard Hall, Manhattan, Kansas 66506). *Applied Spectroscopy;* **42**: No. 7, 1319-1321(Sep 1988).

A sample holder for Raman spectroscopy measurements is described that uses magnets to hold the sample to a steel back surface. (AIP)

9109 **(ESA-TT—1090) Modeling of pulsed gas flow lasers.** Offenhaeuser, F. (European Space Agency, 75 - Paris (France)). Jun 1988. Transl. into ENGLISH of Modellierung von Gepulsten Gasstromungslasern, Stuttgart, Federal Rep. of West Germany (DFVLR). (DFVLR-FB—87-19; ETN—88-93052). 143p. NTIS, PC A07/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 50.50 deutsche marks.

Very complex simulation problems, occurring in the description of pulsed gas flow lasers were modeled. The fundamentals of the laser model are described. The computer code has the property that the type of laser is specified by a data file only. Hence, the laser model can be applied without changes of the computer program to all gas flow lasers whereby gas flow, optical axis, and a possible electrical excitation act perpendicularly to each other.

9110 **High speed photography, videography, and photonics V; Proceedings of the Meeting, San Diego, CA, Aug. 17-19, 1987.** Johnson, H.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). 402p. (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

Recent advances in high-speed optical and electrooptic devices are discussed in reviews and reports. Topics examined include data quantification and related technologies, high-speed photographic applications and instruments, flash and cine radiography, and novel ultrafast methods. Also considered are optical streak technology, high-speed videographic and photographic equipment, and X-ray streak cameras. Extensive diagrams, drawings, graphs, sample images, and tables of numerical data are provided.

9111 **Rotating mirror streak camera with an optional image intensifier camera back.** Winslow, O.G.; Davis, W.C. (Los Alamos National Lab., Los Alamos, NM (US)). pp 96-100 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The Combination Camera described here is a traditional rotating-mirror streak camera with several modern improvements, including an optional image intensifier camera back for use with weak light sources. It is intended for use in routine testing of high explosive devices, and for experimental studies of detonation phenomena. The mechanical design is carefully thought out to make precision alignment of the camera to the subject easy, and to make focusing quick and accurate. Interchangeable slit mountings provide single, multiple, and special slits that are accurately aligned to maximize the useful information from an experiment. The image intensifier provides light gains up to 5,000, so that sources with equivalent blackbody temperatures as low as 1500 K can be recorded with exposure times as small as 5 ns. The length of a single slit is 28 mm, and the total height of a multiple slit pattern can be as much as 28 mm. The film back for use without intensification uses 70-mm roll film, and the film back for use with the intensifier uses 4x5 film. Measured resolution on film is 60 lp/mm without intensification, and 16 lp/mm with intensification at maximum gain, and 18 lp/mm at lower gain. The camera has been found especially useful for laser interferometric velocimetry using a Fabry-Perot interferometer as the dispersing element, where light gain is usually necessary even with the largest lasers as light sources.

# 45 EXPLOSIONS AND EXPLOSIVES

*REFER ALSO TO CITATION(S) 8604*

## 4501 Chemical

9112 **(AD-A—197171/2/XAB) PHETS (Permanent High Explosive Test Site) lightning hardening program: Misty Picture Event. Final report, January-November 1987.** Chapman, G.P.; Gardner, R.L.; Lu, G.S.; Rison, W.; Gurbaxani, S.H. (Mission Research Corp., Albuquerque, NM (USA)). Jun 1988. 90p. (AMRC-R—919). NTIS, PC A05/MF A01.

The Permanent High Explosive Test Site (PHETS) test-bed electrical topology and data flow are presented along with various equipments used in the topology. Using this information, recommendations are made to harden the test-bed instrumentation to electrical transients. These transients may be caused by lightning or electrostatic discharge. Specific attention is given to the junction box design, the shorting blocks, use of shielded cables, protection of the sensors, and the instrumentation bunker/container. Additional attention is given to the protection of personnel from lightning effects. Also, it is recommended the optimum design is of a Faraday-cage concept that completely encases the instrumentation from sensor to permanent recording medium. The optimum design should be prototyped and tested using the Precision Test bed and current injection before general application to the PHETS.

9113 **(AD-A—199532/3/XAB) Axisymmetric calculations for the large blast/thermal simulator (Lb/Ts) shock tube configuration. Technical report, January-September 1986.** Hisley, D.M.; Molvik, G.A. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Sep 1988. 58p. (BRL-TR—2935). NTIS, PC A04/MF A01.

Computational fluid dynamics is a tool that predicts the gas dynamics of blast problems of interest to the Army by solving a set of mathematical equations with a high-speed digital computer. The governing equations for the blast problems presented here are the two-dimensional unsteady Euler equations. The computations were performed on a Cray XMP/48 supercomputer by discretizing the Euler equations with an upwind, Total Variation Diminishing, finite volume, implicit scheme. Details of the scheme are presented. The algorithm is used here to provide gas-dynamic information for a candidate large-scale blast simulator (LBS) concept. A growing need exists for nuclear-blast survivability testing of tactical equipment. In order to meet this need, research is conducting into the design and operation of a Large-scale Blast Thermal Simulator, essentially a large multi-driver shock tube. Experiments with heated and unheated driver gas were performed in a single driver, 1/67-scale model of the LB/TS design concept but without the thermal simulation (LBS). One-dimensional calculations were performed for the 1/67-scale LBS with useful results. However, the one-dimensional calculations have had limited success for accurately predicting the flow through the diverging portion of the LBS design because the flow in this region is multi-dimensional. The flow is multi-dimensional due to the rapid and large area change that exists in the diverging nozzle. The paper presents results which demonstrate the nature of fluid physics in the 1/57 scale LBS.

9114 (IES—8801, pp 53-54) **Basic research for the development of explosion-proof sheet.(Part 1) Blast wave in a tunnel which acts on explosion-proof sheet.** Nakamura, Shigeyuki; Fukushima, Tadashi; Aiga, Yutaka; Tanaka, Mitsuru; Mizuno, Keizo. (Taisei Corp., Tokyo, Japan; The Japan Carlit Co., Ltd., Yokohama, Japan). 11 May 1988. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755327/JAW.

In Transactions of annual meetings 1988 of the Industrial Explosives Society, Japan.

With the objectives of improving safety of the work using blasting and shortening the work cycle time, explosion-proof sheets are being developed. For the sheets, alamid fiber based or polyethylene based film materials which have ultra high tension and are very flexible are used. In order to develop the sheets, the basic data

concerning the attenuation of blast wave by distance as well as the flying conditions of sands and rocks at the time of blasting and the dynamic character of the sheets are necessary. Blasting is used for tunnel digging, breaking stones and wrecking works in cities, etc., but in this research, the tunnel blasting, in which the blast waves and the flying stones progress unidimensionally, is chosen. Experiments concerning blast waves in a tunnel were conducted and the following result was obtained inter alia: since delayed blasting was done in tunnel digging, it was proper to calculate the converted distance (actual distance/explosive charge) in this case by applying the explosive charge per stage. (3 figs, 1 tab, 2 refs)

9115 (IES—8801, pp 55-56) **Basic research for the development of explosion-proof sheet. (Part 2)Small scale explosion experiment using hume pipe.** Mizuno, Keizo; Tanaka, Mitsuru; Aiga, Yutaka; Fukushima, Tadashi; Nakamura, Shigeyuki. (Taisei Corp., Tokyo, Japan; The Japan Carlit Co., Ltd., Yokohama, Japan). 11 May 1988. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755327/JAW.

In Transactions of annual meetings 1988 of the Industrial Explosives Society, Japan.

In order to grasp deformation of an explosion-proof sheet at the time of its receiving blast waves, a small scale blasting experiment using a concrete hume pipe for an explosion-proof sheet was conducted. The explosion-proof sheet was made by sewing felt or high tension nets to the film materials made of extremely highly tensional and flexible alamid-based or polyethylene-based fibers. In this experiment, the sheet of the alamid fiber film material was used. As a result, it was elucidated that the displacement of one sheet of the explosion-proof sheet agreed approximately with its behavior calculated by the proposed formula. However, in the actual conditions, several explosion-proof sheets are tightly fastened with ropes or magic tapes, etc. for use and receive flying stones in addition to blast waves. Consequently, it is necessary to conduct a comprehensive study in the future through demonstration experiments concerning the actual use of the explosion-proof sheet and accumulation of the data concerned. (4 figs, 2 tabs, 2 refs)

9116 (MLM—3518(OP)) **Application of rigorous nonlinear regression for the analysis of complex isothermal DSC reactivity curves.** Pickard, J.M. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). [1988]. Contract AC04-88DP43495;AC04-76DP00053. 7p. (CONF-8810123—3). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003144/JAW.

From 17. North American Thermal Analysis Society (NATAS) conference; Orlando, FL, USA (9 Oct 1988).

Differential scanning calorimetry (DSC) provides a convenient technique for monitoring the global reactivity in real time for decomposition of a variety of secondary explosives. Thermograms for decomposition of explosives are frequently characterized by nonzero initial rates followed by additional transitions involving autocatalysis. An example of this phenomenon is illustrated for decomposition of 2,2',4,4',6,6'-hexanitroazobenzene (HNAB) at temperatures of 590 and 600K. Thermograms exhibit nonzero initial rates followed by autocatalytic transitions exhibiting maxima in the range of 250--500 s. In view of the complexity and frequency of occurrence of these types of thermograms, a computer program was devised to evaluate global rate parameters using nonlinear regression. 7 refs., 5 figs., 1 tab.

9117 (SAND—88-2902) **Analysis of the accidental explosion at Pepcon, Henderson, Nevada, May 4, 1988.** Reed, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 61p. NTIS, PC A04 - OSTI. Order Number DE89004503/JAW.

Several hours of fire and numerous explosions destroyed the Pacific Engineering Company plant in Henderson, Nevada, that manufactured ammonium perchlorate (AP) for rocket fuel. This incident began about 1130 PDT on May 4, 1988, with a fire in their Batch House that grew out of control and caused a first large explosion at about 1153 PDT. The final and largest explosion occurred about 1157 PDT. Damages to the surrounding community were surveyed and interpreted as airblast overpressures versus distances, which allowed an estimate of 1-kiloton nuclear free-air-burst for the equivalent explosion yield. This could be reproduced by 250-tons TNT burst on the ground surface. Weather reports were obtained from the National Weather Services which indicated somewhat enhanced airblast propagation downwind toward northerly directions and attenuated airblast propagations upwind in southerly directions. It was impossible, for lack of winds aloft information below about 500 m above ground, to determine whether there was any atmospheric acoustic airblast focusing. Several seismic recordings in Las Vegas showed the greatest ground motion resulted from the airblast wave passage, traveling at near acoustic speed. Ground wave arrival times were not sufficiently precise to allow seismic speed interpretations. Of the 4000 tons of AP apparently stored in and around the plant, it appears that about 1500 tons detonated in the largest explosion. This leads to a conclusion that the TNT airblast equivalence factor for AP is near 1/6. An independent estimate, based on analysis of more ideal close-in structural deformations, suggested an equivalence factor of 1/3. 25 refs., 12 figs., 14 tabs.

9118 (UCID—21575) **Shock compression and initiation behavior of FEFO.** Simpson, R.L.; Helm, F.H.; von Holtz, E.H. (Lawrence Livermore National Lab., CA (USA)). 11 Nov 1988. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004605/JAW.

A series of experiments were carried out on FEFO to determine the non-reactive equation of state and initiation sensitivity to one- dimensional shock loading. The material was found to be extremely insensitive requiring approximately 13.0 GPa to initiate it. Pressure records indicate that the build-up to detonation may occur within the FEFO and not at the impactor-sample interface as is often assumed. In addition, it was found that the compression vs. detonation induction time behavior between FEFO and three nitroalkanes are approximately the same although the shock pressure thresholds are quite different. 9 refs., 5 figs., 1 tab.

9119 **High temperature detonator.** Johnson, J.O.; Dinegar, R.H. (to to the Dept. of Energy). US Patent Application 6-020,999. 2 Mar 1987. 15p. Contract W-7405-ENG-36. DE89000109 NTIS, PC A03/MF A01 - OSTI. Order Number DE89000109/JAW.

A detonator assembly is provided which is usable at high temperatures about 300{degree}C. A detonator body is provided with an internal volume defining an anvil surface. A first acceptor explosive is disposed on the anvil surface. A donor assembly having an ignition element, an explosive material, and a flying plate, are placed in the body effective to accelerate the flying plate to impact the first acceptor explosive on the anvil for detonating the first acceptor explosive. A second acceptor explosive is eccentrically located in detonation relationship with the first acceptor explosive to thereafter effect detonation of a main charge. 2 figs., 1 tab.

## 4502 Nuclear

*REFER ALSO TO CITATION(S) 7913, 8603, 9746, 10595*

9120 (AD-A—197314/8/XAB) **Pacific Enewetak Atoll Crater Exploration (PEACE) Program, Enewetak Atoll, Republic of the Marshall Islands. Part 4. Analysis of borehole gravity surveys and other geologic and bathymetric studies in vicinity of Oak and Koa craters.** Henry, T.W.; Wardlaw, B.R. (Geological Survey, Denver, CO (USA)). 1987. 399p. (—87-665). NTIS, PC A17/MF A01.

See also Part 3, AD-A177 705. Includes envelope with 9 charts.

The Pacific Enewetak Atoll Crater Exploration (PEACE) Program was established to resolve a number of questions for the Department of Defense (DOD) about the geologic and material-properties parameters of two craters (KOA and OAK), formed by near-surface bursts of high-yield thermonuclear devices on the northern margin of Enewetak Atoll, Marshall Islands, in 1958. The multidisciplinary studies conducted by the USGS in collaboration with other organizations during 1984 through 1987 were part of a much larger research initiative by the DNA to better understand the dynamic properties of strategic-scale nuclear bursts and the relevance of the Pacific Proving Grounds (PPG) craters to issues of strategic basing and targeting of nuclear weapons. Major topics in-

clude: Borehole gravity; Palentologic evidence for mixing; Electron paramagnetic resonance studies; Bathymetric studies of OAK crater; Constraints on densification and piping for OAK; and Additional studies of geologic crater models.

9121 **(AD-A—197325/4/XAB) Deactivation of the ground-launched cruise-missile training system, 868 Tactical Missile Training Group. Student report.** Chiofolo, J.M.; O'Brien, G.J. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1988. 62p. (ACSC—88-0520). NTIS, PC A04/MF A01.

The 868 Tactical Missile Training Group was activated to conduct field and operations training for the Ground Launched Cruise Missile (GLCM) weapon system. If/when the Intermediate-range and Shorter Range Nuclear Forces (INF) Treaty between the United States of America and the Union of Soviet Socialist Republics is ratified, this mission will no longer be required. This study addresses issues that Tactical Air Command must take into consideration regarding the reassignment, reallocation, utilization, and/or destruction of surplus training equipment. The study makes recommendations in areas of critical and non-critical vehicle uses, assignment suggestions for unit personnel and reallocation of weapons, buildings, and surplus training equipment.

9122 **(AD-A—197326/2/XAB) Ground-based threat to nuclear logistics aircraft during low-altitude flight. Student report.** Baker, A.D. (Air Command and Staff Coll., Maxwell AFB, AL (USA)). Apr 1988. 31p. (ACSC—88-0165). NTIS, PC A03/MF A01.

The purpose of this report is to evaluate and counter the possible terrorist threat of using a small hand-held rocket or missile against a prime nuclear airlift force (PNAF) aircraft during low-altitude flight in Western Europe. Determination of this threat as credible is based on four criteria: known vulnerability, advantages exploitation, obtainable technology, and cost effectiveness. Terrorists are aware of an aircraft's vulnerability to rockets and missiles during low-altitude flight. They are motivated to attack military targets in Western Europe. Terrorists, through their links with Arab terrorist states can obtain these weapons. Finally, terrorists view such an attack as financially and psychologically cost-effective.

9123 **(AD-A—197482/3/XAB) Strategic targeting by Soviet SSBNS (Soviet ballistic-missile nuclear-powered submarines). Final report, December 1987-May 1988.** Tritten, J.J. (Naval Postgraduate School, Monterey, CA (USA)). 16 May 1988. 15p. (NPS—56-88-011). NTIS, PC A03/MF A01.

Declaratory targeting by Soviet Navy strategic missiles carried aboard submarines on forward deployment and in bastions is examined. The role of the Soviet Navy in strategic nuclear reserve is discussed. Soviet acceptance of mutual assured destruction (MAD) is assessed.

9124 **(AD-A—197814/7/XAB) Handbook for nuclear weapons effects under arctic conditions. sanitized. Final report, June 1979-April 1980.** Keith, J.R.; Wallace, W.E. (Kaman Sciences Corp., Colorado Springs, CO (USA)). 30 Apr 1980. 367p. (K—80-143(R)-SAN). NTIS, PC A16/MF A01.

This report describes the changes to be expected in nuclear weapons effects in arctic conditions as compared with the temperature regions of the works. Previous research in this area was reviewed, and relevant information is presented. The emphasis was placed on low-altitude and underwater bursts and effects. Inadequacies and uncertainties in current prediction techniques are given. The characteristics of the arctic region of importance in nuclear-effect calculations are given. The effects considered include air blast, cratering, thermal radiation, nuclear radiation, EMP, HF communication degradation, water shock, water waves, and acoustic effects.

9125 **(AD-A—198195/0/XAB) Technical papers presented at the Defense Nuclear Agency Global Effects Review held in Santa Barbara, California on 7-9 April 1987. Volume 2. Technical report.** (Department of Defense Nuclear Information Analysis Center, Santa Barbara, CA (USA)). 19 May 1987. 386p. (DASIAC-TN—35-V2). NTIS, PC A17/MF A01.

See also Volume 1, AD-A196 157.

Studies have confirmed the possibility of significant temperature decreases and other severe environmental perturbations following a nuclear war, with potentially critical implications for human survival. Nevertheless, important uncertainties remain to be resolved. Fuel Inventories; Fuel Impaction; The quantities of fuels affected by nuclear explosions are sensitive to the scenario adopted. Smoke Emission Factor: Burning petroleum, plastics, and related materials can emit 5% or more of their mass as soot; recent experiments reveal that the combustion of wood under restricted ventilation can convert up to 2% to soot; such emission factors imply blacker smoke than has been presumed in most existing studies. Plume Heights: Simulations and observations indicate initial smoke injection as high as 15 kilometers. Prompt Scavenging: The immediate rainout of the sooty component of smoke emissions is probably less than 50%, because of its poor nucleation properties relative to other materials, and because of the likely overseeding and reduced precipitation efficiencies of smoke clouds. Mesoscale Dispersion; Acute Climate Change: The extent of land surface cooling for a specific smoke injection can presently be estimated to within a factor of 2; Long-term Climate Change: Preliminary investigations show important couplings between smoke injections, oceanic responses, ice formation, and other processes that drive persistent climate fluctuations over periods of years; residual stabilized smoke layers could greatly enhance these effects; uncertainty about the long-term chemical interaction between soot and ozone must be resolved; Other Environmental Effects; Biological Impacts.

9126 **(AD-A—198528/2/XAB) Development of French nuclear forces. Master's thesis.** Wisda, M.J. (Indiana Univ., Bloomington (USA). Dept. of West European Studies). Nov 1987. 124p. NTIS, PC A06/MF A01.

The purpose of this thesis is to examine how and why the French undertook the development of their own nuclear force and through this examination, argue that the French nuclear force is not just a classic example of stereotypical French chauvinism. It is more in line with a nation realizing its potential in reacting to perceived threats to its national reputation, sovereignty, and security and the changes in the world arena brought about by the nuclear age. In examining how the French nuclear force developed, the various stages of research, development, and deployment are chronologically detailed. This chronology covers policy as well as technological and economic considerations. Based on fairly realistic interpretations of the French experience over the last century, French leaders felt justified in developing their own nuclear capability. It was not a sudden process, but a gradual accumulation of insecurities about French prestige, national survival, and domestic stability that required a firm and reliable solution.

9127 **(AD-A—198749/4/XAB) Magnetohydrodynamic (MHD) nuclear weapons effects on submarine cable systems. Volume 1. Experiments and analysis. Final report.** (AT and T Bell Labs., Holmdel, NJ (USA)). Jun 1987. 278p. NTIS, PC A13/MF A01.

This report presents a study of the nuclear weapons magnetohydrodynamic (MHD) effects on submarine communications cables. The study consisted of the analysis and interpretation of currently available data on submarine cable systems TAT-4, TAT-6, and TAT-7. The primary result of the study is that decrease of the effective resistivity with frequency over the available experimental range, coupled with the model results, leads to quite small effective resistivities at the MHD characteristic frequencies, and hence small earth potential differences. Thus, it appears that submarine cable systems are less susceptible to an MHD threat than their land-based counter-parts.

**9128 (AD-A—199187/6/XAB) Regional studies with broadband data. Scientific report No. 1, 6 March 1987-5 March 1988.** McEvilly, T.V.; Johnson, L.R. (California Univ., Berkeley (USA). Dept. of Geology and Geophysics). 15 May 1988. 92p. NTIS, PC A05/MF A01.

A new approach to the inversion of wave-form data for the time-varying moment tensor was developed. The method produces the source model that minimizes the modulus squared of any linear combination of moment-tensor components, subjects to the constraint that the data are satisfied within specified confidence intervals. This method allows the determination of possible source models other than the least-squares solution, enabling one to determine the significance of certain moment tensor properties, for example, the presence or absence of a volume change (isotropic component) in the source. Synthetic tests were used to examine the effect of microseismic noise and lateral heterogeneity on the extreme models of the isotropic component. Lateral heterogeneity is found to have a strong effect on the estimation of the isotropic component of the moment tensor. The method was tested by using long-period wave forms from the Global Digital Seismic Network to estimate the isotropic part of the moment tensor of a deep Bonin Islands earthquake. Modeling indicates that more than 10% of the mechanism might have to be isotropic for detection of volume change in the presence of 10% random noise and only 2% lateral heterogeneity. The least-squares solution indicates that a relatively large change in volume was involved in the source mechanism. However, the minimum extreme solution shows that this volume change is not actually required by the data and thus may not be significant. The method was also tested on near-source data from the nuclear explosion Harzer. In this case, in spite of fairly large error bounds, it can be concluded that the source has a clear explosive component.

**9129 (AD-A—199242/9/XAB) Analysis of amplitude and travel-time anomalies for short-period -waves from NTS (Nevada Test Site) explosions.** Lynnes, C.S.; Lay, T. (Michigan Univ., Ann Arbor (USA). Dept. of Geological Sciences). 1988. 15p. NTIS, PC A03/MF A01.

Pub. in Geophysical Journal, Vol. 92, 431-443(1988).

Short-period P-wave amplitudes from explosions at the Nevada Test Site have strong, slowly varying azimuthal patterns, which may result from receiver effects, tectonic release interference, attenuation differences, or near-source heterogeneity. In order to determine which factor is responsible for the nonisotropic radiation patterns, m/sub b/ and travel-time anomalies were measured for 57 explosions. Magnitude anomalies from 12 earthquakes in the western United States were also determined to characterize the near-receiver effects. The m sub b and travel-time anomalies are positively correlated for the NTS explosions, suggesting the predominance of elastic focusing and defocusing, rather than attenuation or tectonic release effects. Applying the regional event m sub b values as receiver corrections leaves a small common component in the NTS m sub b patterns, which must be produced by velocity heterogeneity deep enough (>200 km) to affect both sites. The travel-time patterns for the two NTS sub-sites are quite similiar and have a systematic counter-clockwise rotation from the FAULTLESS travel-time pattern, indicating that a deep (>400 km) high-velocity anomaly is responsible for the strong common component of the travel-time variations. This suggests that focusing and defocusing by near-source velocity heterogeneity, most of which is probably concentrated in a high-velocity body in the crust and upper mantle (<200 km deep) causes the strong intersite amplitude variations.

**9130 (AD-A—199243/7/XAB) Modeling teleseismic SV waves from underground explosions with tectonic release: results for Southern Novaya Zemlya.** Cohee, B.P.; Lay, T. (Michigan Univ., Ann Arbor (USA). Dept. of Geological Sciences). Jun 1988. 23p. NTIS, PC A03/MF A01.

Pub. in Bulletin of the Seismological Society of America, Vol. 78, No. 3, 1158-1178(Jun 1988).

Detailed forward modeling of long-period shear waves for 2 large underground explosions at the Southern Novaya Zemlya test site indicates that the appropriate equivalent double-couple orientation for the tectonic release radiation is vertical strike-slip. Previous studies of observed teleseismic SH waveforms and SV amplitudes for the 27 Oct 1973 and 2 Nov 1974 events using geometric theory could not distinguish between vertical strike-slip and 45 deg-dipping thrust geometries. Either mechanism can match the observed four-lobed SH radiation pattern, and the two-lobed SV amplitude pattern can be produced by interference with an appropriate-size explosion pS signal. However, the complexity of the observed SV waveforms arising from Sp conversions near the receiver, diffracted Sp, and shear-coupled PL phases is not accounted for in the ray-theory synthetics. Incorporating more-realistic Green's functions using Baag and Langston's WKBJ spectral method allows more-complete modeling of the SV signals. Due to differences in frequency content between the explosion and double-couple SV waveforms, constructive interference occurs more efficiently than destructive interference when the two signals are linearly superimposed. As a result, using tectonic-release moments determined from the SH waves and the optimum F factors required to match the SV amplitude patterns, the waveforms produced by the strike-slip and thrust orientations differ substantially at some azimuths.

**9131 (AD-A—955362/9/XAB) Defense Atomic Support Agency nuclear test summary: Nougart - Dominic. Sanitized.** (Defense Atomic Support Agency, Washington, DC (USA)). 15 Aug 1963. 120p. (DASA—1211-SAN). NTIS, PC A06/MF A01.

**9132 (AD-A—955363/7/XAB) Nuclear test summary - trinity-hardtack. Sanitized.** (Defense Atomic Support Agency, Washington, DC (USA)). 15 Aug 1962. 271p. (DASA—1220-SAN). NTIS, PC A12/MF A01.

Supersedes report dated 1 May 1959.

**9133 (AD-A—955366/0/XAB) Assessment of the Nike Hercules system in the European air defense structure. Sanitized. Final report, July 1975-September 1976.** (BDM Corp., Vienna, VA (USA)). 11 May 1977. 44p. (BDM/W—9330-77-S1-SAN). NTIS, PC A03/MF A01.

**9134 (AD-B—094426/4/XAB) Guide to nuclear-weapons phenomena and effects literature. Technical report, 1 November 1983-31 October 1984.** Gould, K.E. (Department of Defense Nuclear Information Analysis Center, Santa Barbara, CA (USA)). 31 Oct 1984. 64p. (DASIAC-SR—206). NTIS, PC A04/MF A01.

Supersedes Rept. no. DASIAC-SR-102R dated 1972. See also AD-870 931; Distribution limitation now removed.

This is an overview guide to the basic and most-significant literature on nuclear-weapons phenomena and effects. Topics include: Nuclear Weapon Phenomena--Air shock, Ground shock, cratering, and ejecta; Water shock and related phenomena; Initial ionizing radiations; Thermal and optical; EMP environments and interactions; Cloud and fallout; Nuclear Weapon Effects--Aerospace systems; Naval systems; Ground forces field equipment; Structures; EMP and TREE; C3 systems and the atmosphere; Personnel; Civilian sector and the environment.

**9135 (DOE/SF/15929—1) Survivability enhancement study for C³I/BM [communications, command, control and intelligence/battle management] ground segments: Final report.** (Fairchild Space Co., Germantown, MD (USA)). 30 Oct 1986. Contract AC03-85SF15929. 181p. (FSC-ESD—86-368-11). NTIS, PC A09/MF A01 - OSTI. Order Number DE88011554/JAW.

This study involves a concept developed by the Fairchild Space Company which is directly applicable to the Strategic Defense Initiative (SDI) Program as well as other national security programs requiring reliable, secure and survivable telecommunications systems. The overall objective of this study program was to determine the feasibility of combining and integrating long-lived, compact, autonomous isotope power sources with fiber optic and other types of ground segments of the SDI communications, command, control and intelligence/battle management (C³I/BM) system in order to significantly enhance the survivability of those critical systems, especially against the potential threats of electromagnetic pulse(s) (EMP) resulting from high altitude nuclear weapon explosion(s). 28 figs., 2 tabs.

**9136 (PB—89-103303/XAB) Cisk 2-weapon effects. Consequences for the civilian population in different types of shelter. Subreport 2. Nuclear weapons: attack on Sweden.** Wigg, L.; Danielson, G.; Rosander, K.; Ulvsand, T. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jun 1988. 82p. (In Swedish). (FOA-C—20709-2.6). NTIS, PC E04/MF A01.

In order to generate input to a study carried out by the National Rescue Services Board during 1988 the Swedish Defense Research Establishment has analyzed consequences from nuclear explosions on Swedish territory. The work comprises two parts, one bearing upon air bursts and the other upon surface bursts. For air bursts the degree of protection was varied from the case where the population in the area concerned all are staying in their normal dwellings or out-of-doors to the case where all are to be found in shelters. The results indicate the importance of paying attention to protection against fire hazards. The work on surface bursts has been wholly devoted to fallout. Problems at various distances from the explosion with different protection levels against ionizing radiation have been analyzed. The importance of reaching a shelter early compared to reaching one offering optimal protection is demonstrated. The question of when to evacuate a fallout area was also studied.

**9137 (PB—89-117329/XAB) Rupture of the tympanic membrane in different species by applying varying pressures. 1-gradualiy increasing excess pressure waves in a closed circuit.** Franke, R.; Vassout, P.; Evrard, G. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 16 Feb 1988. 55p. (In French). (ISL-R—104/88). NTIS, PC E04/MF E04.

Text in French; summary in German and English.

The conditions under which an eardrum subjected to gradually increasing excess pressure will break were studied in five species of animals: cats, chinchillas, guinea pigs, hamsters, and rats. Such a build-up of pressure is of interest because of its similarity to what occurs in a more or less airtight shelter exposed to a nuclear blast. Excess pressure was applied to the eardrum in a closed circuit; the pressure's upward slope was linear. Results show that the moment of rupture was only slightly influenced by the upward slope for the values explored. Taking all species together, 30% of the lesions were located in the anterior of the eardrum, 20% in the lower part, and 50% in the posterior part. The study will be completed by similar, real-life studies involving exposure to shock waves in a free field and to excess pressure waves in an enclosed space (an armored vehicle subjected to a simulated nuclear blast). Results of all the studies will be synthesized and relations with the physical and anatomophysiological parameters peculiar to each species will be established so that lessons applicable to man can be deduced.

**9138 (UCID—21474) Material properties study of the MJ-2 grout.** Larson, D.B. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003707/JAW.

Material properties experimental tests using the high pressure testing equipment at LLNL have been performed on the grout used in the Mini Jade-2 event (MJ-2) as part of a high pressure equation of state study sponsored by the Defense Nuclear Agency in support of the Misty Echo experiment at the Nevada Test Site. The material properties tests performed at LLNL and included in this report are (1) pressure-volume compression studies to 3.6 GPa, (2) pressure-volume compression and unloading studies to {approximately}1 GPa, and (3) material strength versus confining pressure to {approximately}1 GPa. These data are compared with dynamic results and with other static data using this grout. 4 refs., 5 figs., 4 tabs.

**9139 (UCID—21592) Predicted and measured deflections of the Schellbourne and Contact nuclear test canisters.** McCallen, D.B.; Locke, F.E. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 48p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004983/JAW.

A detailed study of stiffening schemes for nuclear test canisters has been performed. The study included both numerical computer simulations and field measurements of the deformations of canisters under carefully controlled applied loads. The results of the study provide quantitative information on the degree of stiffening which has been achieved by the various stiffening techniques. The work performed also allowed direct comparison between specialized reduced-order continuum canister models; large, discrete finite element canister models, and measured canister deflections. This report summarizes the computer simulations, discuses the effectiveness of the stiffening schemes, and documents the experimental data. 18 refs., 23 figs., 7 tabs.

### 4503 Explosion Detection

*REFER ALSO TO CITATION(S) 9111, 9615*

**9140 (AD-A—198121/6/XAB) High-frequency seismic-source characteristics of cavity-decoupled underground nuclear explosions. Technical report No. 1, 22 March 1987-22 March 1988.** Murphy, J.R.; Stevens, J.L.; Rimer, N. (S-Cubed, San Diego, CA (USA)). May 1988. 76p. (SSS-R—88-9595). NTIS, PC A05/MF A01.

This research investigated the high-frequency characteristics of the seismic sources corresponding to cavity-decoupled nuclear explosions and to assess the implications of these investigations with regard to the detection and discrimination of small decoupled explosions. The study was carried out using a combination of deterministic simulations and analyses of empirical data recorded from selected cavity-decoupled explosions. With regard to the deterministic simulations, a series of nonlinear finite-difference calculations were performed to simulate cavity-decoupled explosions in unsaturated tuff and salt emplacement media. These simulations have confirmed the fact that the simple-step pressure approximation is not valid at high-frequencies and that the initial pressure spike on the cavity wall can induce significant nonlinear response. Preliminary analyses of high-frequency seismic data recorded from the STERLING decoupled explosion in salt and the MILL YARD decoupled explosion in unsaturated tuff have provided evidence that the high frequency source components associated with the complex cavity pressure loadings do effectively couple into the seismic regime, in agreement with the predictions of the nonlinear finite-difference simulations.

**9141 (FRCEA-TH—140) Treatment of multicomponent microbarographic signals excited by high power explosions.** Delclos, C. (Institut National Polytechnique, 38 - Grenoble (France)). Apr 1986. 162p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756017/JAW.

A method for analysis of microbarographic signals recorded on a sensor network is developed, the aim is the localization of the source with maximum accuracy. It is shown that the method using the interspectral matrix finds a direct application in the discrimination of waves from high power explosion in a noisy environment. Its powerfulness is demonstrated on actual signals (explosion of the volcano Mt St Helens) allowing interesting results on propagation mechanisms (Brunt period, Lamb modes and acoustic modes).

## 50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

**9142 (GSF—21/87) Concept for early recognition and assessment of environmental changes.** Schmidt-Bleek, F.; Peichl, L.; Behling, G.; Mueller, K.W.; Reiml, D.; Buesing, J.; Hamann, H.J.; Ritzl, I. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Nuklearbiologie). Aug 1987. 66p. (In English, French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755980/JAW.

In 1985 a project was established at the National Center for Environmental Research (GSF-Munich-Neuherberg) to develop a 'concept for the early recognition' of signals for changes in the environment and consequences in human health. Its application was to improve the chances of timely efforts for the scientific assessment of environmental changes and thus open the way to improved

abatement and protection decisions. The project was supported in its work by the Council for Early Recognition. With curcial support from this Council, a braod spectrum of possible approaches was considered and some were selected which seem to offer the promise of improvements in the near future. The selected approaches are: Data acquisition and treatment; manipulation of routine data on the environment, collection and analysis of observations from the public, acquisition and analysis of data on chemicals, integration and manipulation of health-data, development and application of key indicators; execution of concise studies in environmental problem areas.

## 5001 Basic Studies

*REFER ALSO TO CITATION(S) 9217*

**9143 (CONF-8802114—1) Minisodar measurements of rain.** Coulter, R.L.; Martin, T.J.; Weckwerth, T.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003885/JAW.

From 4. symposium of the International Society of Acoustic Remote Sensing and 2. Australasian conference on the physics of remote sensing of atmosphere and ocean; Canberra, Australia (16 Feb 1988).

Measurements of raindrop fall velocity spectra have been made with a minisodar. Amplitude calibration of the system enables the calculation of drop size parameters such as number density, water density, and surface area using methods similar to those with radar studies. The acoustic measurements are at 10 m intervals within 200 m of the surface and benefit from an almost complete separation of droplet velocity spectra from atmospheric vertical velocity spectra. Comparison of parameters with the literature shows good agreement. It is shown that the chief difficulty with the method is atmospheric attenuation; however, excess attenuation due to scattering from droplets is found to be unimportant. 24 refs., 7 figs., 2 tabs.

**9144 (LA-UR—88-3317) Study of stability zone influences and tracer patterns from the 1987 ANATEX [Across North America Tracer Experiment] experiment.** Porch, W.M.; Gifford, F.A.; Hoard, D.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 15p. (CONF-890133—3). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002050/JAW.

From 6. joint conference on applications of air pollution meteorology; Anaheim, CA, USA (29 Jan 1989).

In this paper, we will show preliminary results which appear to connect much of the hit and miss behavior of the surface tracer samples to large scale stability zones 100 to 1000 km wide. With these wintertime stability effects in mind, we have done the best we can to characterize the observed overall tracer patterns as well as individual tracer releases. This type of survey information is important to numerical model development. Diagnostic models often have difficulty reproducing surface plume concentrations where transport over stable layers have occurred. Prognostic models can, in theory, model effects of strong stable layers. However, these models would have great difficulty predicting large scale stable regions such as those observed during ANATEX. Also, though these models have ways of budging in synoptic wind fields, temperature observations are presently ignored. This is because if both wind and temperature observations are forced too strongly into the model, conflicting results may be produced. 12 refs., 5 figs.

**9145 (N—88-29233) Present state of knowledge of the upper atmosphere 1988: an assessment report.** Watson, R.T.; Prather, M.J.; Kurylo, M.J. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1988. 203p. (NASA-RP—1208; NAS—1.61:1208). NTIS, PC A10/MF A01.

This document was issued in response to the Clean Air Act Amendments of 1977, Public Law 95-95, mandating that NASA and other key agencies submit biennial reports to Congress and EPA. NASA is to report on the state of our knowledge of the upper atmosphere, particularly the stratosphere. This is the sixth ozone assessment report submitted to Congress and the concerned regulatory agencies. Part 1 contains an outline of the NASA Upper Atmosphere Research Program and summaries of the research efforts supported during the last two years. An assessment is presented of the state of knowledge as of March 15, 1988 when the Ozone Trends Panel, organized by NASA and co-sponsored by the World Meteorological Organization, NOAA, FAA and the United Nations Environment Program released an executive summary of its findings from a critical in-depth study involving over 100 scientists from 12 countries. Chapter summaries of the International Ozone Trends Panel Report form the major part of this report. Two other sections are Model Predictions of Future Ozone Change and Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling. Each of these sections and the report in its entirety were peer reviewed.

**9146 (UCID—21601) Data structure and memory management in the NCAR/LLNL Community Climate Model (CCM1L).** O'Connor, C.; Covey, C. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004986/JAW.

Extensive modifications of the Community Climate Model Version 1 (CCM1) were required, after this computer code was imported from the National Center for Atmospheric Research, to enable efficient execution in the computing environment of the Lawrence Livermore National Laboratory. Most of the modifications involved storage and transfer of large data sets as the model executes. The management of these data sets was generalized to permit users to select among a variety of fast storage media{endash}internal memory, solid state storage devices, or disk{endash}depending on their availability and their suitability for optimum performance on present and future supercomputer systems. We describe these additions to the CCM1 code and related modifications to its data files. In the optimum configuration of the LLNL version of CCM1, the code is run on a Cray XMP computer with attached Solid-State Storage Device; working files are maintained in internal memory or the SSD, while input and output files are buffered from and to disk. This procedure results in a great reduction in input/output overhead. 2 refs., 19 figs.

**9147 (UCRL—100032) Impacts of climate change on California water resources.** Knox, J.B.; Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA)). 28 Nov 1988. Contract W-7405-ENG-48. 8p. (CONF-881218—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004015/JAW.

From 2. North American conference on preparing for climate change; Washington, DC, USA (6 Dec 1988).

Present policies for California's water system management are based on existing water law and contractual arrangements, and on the previously credible assumption that the water supply of the future can be predicted from the past weather/climate observations. Because of the high economic and political stakes, divided authority, and the complex network of historically developed water law and policy, management policies tend to be very conservative and oriented to present and past conditions. Present policies will be influential far into the future, however, because of the long lead times required for legal and political change, and for authorization and construction of major engineering projects. It is the thesis of this paper that very probable and reliably predictable aspects of climate change (the greenhouse effect) could seriously affect California's water distribution system. We address in this paper some of the policy, management, and research needs that will have to be met if the state's water system is to anticipate, prepare for, and operate resiliently in, a changing environment. 2 refs.

**9148 ENSO signal in continental temperature and precipitation records.** Bradley, R.S.; Diaz, H.F.; Kiladis, G.N.; Eischeid, J.K. (Univ. of Massachusetts, Amherst (USA)). *Nature (London);* **327**: 497-501(11 Jun 1987).

Warm events in the tropical Pacific Ocean, associated with one extreme of the Southern Oscillation (generally known as El Nino-Southern Oscillation or ENSO events) are now known to be of global significance in perturbing the general circulation of the atmosphere. It is also apparent that episodes of enhanced cold water upwelling (cold events) have an impact on large-scale atmospheric

circulation patterns. Here the authors examine the effect of warm and cold events on short-term fluctuations of continental surface air temperature and precipitation throughout the Northern Hemisphere using a newly compiled set of high-quality temperature and precipitation data. The data were in the form of gridded anomalies from a 1951-1970 reference mean for temperature and a 1921-60 reference mean for precipitation.

9149 **US-USSR meeting of experts on causes of recent climate change.** Budyko, M.I.; MacCracken, M.C. (State Hydrological Institute, Leningrad (USSR)). *Bulletin of the American Meteorological Society;* **68**: No. 3, 237-243(Mar 1987). Contract W-7405-ENG-48.

The global nature of the problem of inadvertent climate change makes it imperative that research be conducted on an international basis. The authors bilateral efforts have proven highly productive in advancing understanding of the problem. Vigorous efforts to integrate the atmospheric, hydrospheric, lithospheric, and biological sciences into the new discipline of earth systems science offer the potential for systematic and interactive advancing of their understanding. The need for such integrating efforts has emerged from studies of anthropogenic climate change; the implications for science are much more far-reaching. Their pursuit of such studies should further understanding of the global ecosystem and help to maintain the habitable environment that we share.

## 5002 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7244, 7249, 7282, 7318, 7340, 7346, 7382, 7720, 7723, 7889, 7953, 8025, 8026, 8050, 8087, 8461, 8477, 8602, 8782, 8783, 8784, 9316, 9370, 9383, 9469, 9527, 9551, 9552, 9555, 9560, 9562, 9563, 9566*

9150 **(AD-A—197563/0/XAB) Investigation of groundwater pollution at Air Force Plant Number 4, Fort Worth Texas.** (Army Engineer District, Fort Worth, TX (USA)). Oct 1986. 159p. NTIS MF A01.

Availability: Microfiche copies only.

Beginning in December 1982, an extensive investigation was conducted to determine the presence and extent of industrial chemical pollution at Air Force Plant No. 4. A major portion of this work was devoted to the testing of ground water flowing within the overburden. In addition, 16 wells were drilled to monitor for polluted ground water in the upper and middle zones of the Paluxy Formation. Paluxy ground water was monitored; trichloroethylene, 1,2-trans-dichloroethylene, and lesser amounts of other chlorinated hydrocarbons, and the existence of abnormally high water levels in the upper zone of the Paluxy Formation in well P-8(U) were discovered.

9151 **(AD-A—197864/2/XAB) Aircraft emissions characterization. Final report, September 1986-August 1987.** Spicer, C.W.; Holdren, M.W.; Miller, S.E.; Smith, D.L.; Smith, R.N. (Battelle Columbus Labs., OH (USA)). Mar 1988. 74p. NTIS, PC A04/MF A01.

Assessment of the environmental impact of aircraft operations is required by Air Force regulations. This program was undertaken to quantify gaseous and particulate emissions associated with three Air Force turbine engines (TF33-P3, TF33-P7, and J79 (smokeless). The emissions tests were carried out, using a test cell at Tinker AFB, Oklahoma City, OK. All tests employed JP-4 as the fuel, and fuel samples were characterized by standard tests and analyzed for composition. Emissions were measured at power settings of idle, 30%, 75%, and 100%. Measurements were made of detailed organic composition, CO, $CO_2$, NO, NOx, smoke number, particle concentration, and particle-size distribution. A multiport sampling rake was used to sample the exhaust, and heated Teflon tubing was used to transfer exhaust to the monitoring instrumentation. Measured and calculated fuel/air ratios were compared to assure representative sampling of the exhaust. The results have been used to calculate emission indices and emission rates for CO, $CO_2$, total hydrocarbons, NO, $NO_2$, and NOx. The distribution of organic compounds in the exhaust from the different engines and at various power settings was compared, and the distribution by compound class and by carbon number are reported. Smoke numbers and particle-size distributions were derived from the test data. The report also contains a review of the emissions of selected toxic chemicals, and a comparison with other emission sources.

9152 **(AD-A—198092/9/XAB) Volatile organic compound and particulate emission studies of AF (Air Force) paint-booth facilities. Phase 1. Final report, February-December 1987.** Ayer, J.; Wolbach, D. (Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.). Jul 1988. 105p. NTIS, PC A06/MF A01.

This study presents the results of volatile organic compound (VOC) and particulate emission surveys performed at three Air Force painting facilities. The three facilities -- one in McClellan AFB buildings 655 and two at Travis AFB in buildings 550 and 1014 -- did not meet local VOC emission standards. The possibility of reducing these emissions with recirculation modifications and various VOC reduction and control strategies is discussed. Although VOC emissions from paint spray booths can be controlled by add-on control systems, control is expensive for present air flow rates. The use of air recirculation within the spray booth can reduce the cost of VOC emission controls by reducing the quantity of air that requires processing. Recirculation systems were designed for two of the painting facilities included in this study. In designing the systems, various criteria such as paint booth VOC concentrations and health and safety standards were considered. Add-on VOC emission-control systems that can be used in conjunction with the recirculation system are evaluated. The devices of interest are a solvent incineration system and an activated-carbon adsorption bed. The VOC removal efficiency, initial capital investment and operating costs for both of these technologies are discussed.

9153 **(AD-A—198288/3/XAB) Manual-calculation methods for air-pollution inventories. Final report, August 1985-February 1988.** Fagin, G.T. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). May 1988. 200p. (USAFOEHL—88-070EQ0111EEB). NTIS, PC A09/MF A01.

In the assessment and control of air pollution, there is a critical need for reliable and consistent data on the quantity and characteristics of emissions from the numerous sources that contribute to the problem. The large number of individual sources and the diversity of source types makes conducting field measurements of emissions impractical on a source-by-source basis. The only feasible method of determining pollutant emissions for a given community or base is to make general emission estimates typical of each of the source types. Compilation of these emission estimates or airborne pollutant discharges including oxides of nitrogen (NO(x)), oxides of sulfur (SO(x)), hydrocarbons (HC), carbon monoxide (CO), and particulates (PA) over a period of time, usually one year, is referred to as an Emissions Inventory. A useful tool for estimating general emissions for an emissions inventory is the emission factor. This is an estimate of the rate at which a pollutant is released to the atmosphere as a result of some activity (such as combustion or industrial production) divided by the level of that activity. The use of emission factors for manual calculation of emissions as well as data-collection procedures necessary for completion of the emissions inventory are provided within. This report provides guidelines for bioenvironmental engineers and technicians on how to perform Air Emission Inventories (AEIs). This report provides example calculations, blank data sheets, emission factors, and an example completed AEI.

9154 **(AD-A—198478/0/XAB) Comparison of particulate lead levels for different ammunition types used with the M16 rifle. Final report, July 1987-June 1988.** Hoke, S.H.; Beard, A.S.; Brueggemann, E.E.; Rosencrance, A.B. (Army Biomedical Research and Development Lab., Fort Detrick, MD (USA)). 1 Jul 1988. 19p. (USABRDL-TR—8803). NTIS, PC A03/MF A01.

Airborne lead generated during firing of conventional ammunition has lead to health concerns at indoor firing ranges. This study compares the relative amounts of airborne lead produced by the M16 rifle firing the M193 standard M16 5.56-mm conventional ammunition, the M862 5.56-mm plastic training ammunition, and the conventional caliber .22 rifle cartridge. Both breech and breech-plus-muzzle lead emissions were determined for each type of ammunition.

**9155 (AD-A—198691/8/XAB) Atmospheric photochemical modeling of turbine-engine fuels and exhausts. Phase 2. Computer model development. Volume 2. Final report, October 1984-December 1986.** Carter, W.O.; Winer, A.M.; Atkinson, R.; Heffron, S.E.; Poe, M.P. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). May 1988. 210p. NTIS, PC A10/MF A01.

See also Volume 1, AD-A198 690.

This User's Manual documents how to use an atmospheric photochemical reactivity modeling software system developed for the U.S. Air Force under this contract. The modeling software can be used to conduct 'floating box' type airshed model simulations to determine the air quality impacts of many types of reactive organic gases (ROG) emitted under a variety of air-pollution scenarios.

**9156 (AD-A—199002/7/XAB) Source-emission testing of hospital and classified-waste incinerators, Plattsburgh AFB, New York. Final report.** Garrison, J.A. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jul 1988. 77p. (USAFOEHL—88-098EQ0159GEF). NTIS, PC A05/MF A01.

Source-emission testing for particulates and hydrogen chloride emissions was conducted on the USAF Hospital pathological incinerator at Plattsburgh AFB. This survey was requested to evaluate emissions with respect to a proposed New York State Standard for medical care facility-waste incinerators. The 380 BMW/MSS classified-waste incinerator was also tested because of concerns that similar emissions could be produced from this unit. Results indicate that the hospital incinerator did not meet the present air-emission standards or proposed standards with the exception of hydrogen chloride (HCl) emissions. The classified-waste incinerator met both standards with respect to visible emissions but did not meet the standards for particulate emissions. Although not required by present or proposed regulations, the classified waste incinerator was evaluated for HCl emissions; results indicate that this unit met the proposed HCl emissions standards for infectious waste incinerators. Since only one sample run of the three required by testing methods could be accomplished on the classified-waste unit, results should only be used as an indicator of performance and not as definite evidence of either meeting or failing to meet regulations.

**9157 (AD-A—199003/5/XAB) Microcomputer pollution model for civilian airports and Air Force bases. Model description.** Segal, H.M.; Hamilton, P.L. (Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy). Aug 1988. 140p. (FAA-EE—88-4). NTIS, PC A07/MF A01.

See also rept. nos. FAA-EE-88-3 and FAA-EE-88-5.

This is one of three reports describing the Emissions and Dispersion Modeling System (EDMS). EDMS is a complex source emissions/dispersion model for use at civilian airports and Air Force bases. It operates in both a refined and a screening mode and is programmed for an IBM-XT (or compatible) computer. This report--MODEL DESCRIPTION--provides the technical description of the model. It first identifies the key design features of both the emissions (EMISSMOD) and dispersion (GIMM) portions of EDMS. It then describes the type of meteorological information the dispersion model can accept and identifies the manner in which it preprocesses National Climatic Center (NCC) data prior to a refined-model run. The report presents the results of running EDMS on a number of different microcomputers and compares EDMS results with those of comparable models. The appendices elaborate on the information noted above and list the source code.

**9158 (AD-A—199096/9/XAB) User's guide for the Air Force Toxic Chemical Dispersion Model (AFTOX). Interim report, October 1985-December 1987.** Kunkel, B.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 4 Jan 1988. 65p. (AFGL-TR—88-0009). NTIS, PC A04/MF A01.

A Gaussian puff/plume dispersion model for uniform terrain and wind conditions is described. The program, written in BASIC language, will run on IBM compatible and Zenith-100 microcomputers. It will handle continuous or instantaneous, liquid or gas, elevated or surface releases from a point or area source. The program contains an additional option for continuous heated plumes from stacks. The model will 1) plot concentration contours, 2) compute concentration at specified point and time, and 3) compute maximum concentration at given elevation and time. The model has many unique features, including the computation of a continuous stability parameter, the inclusion of the concentration averaging time and surface roughness, the ability to print now or save/print later, the ability to correct input data without restarting, easy access to chemical data file for adding, deleting and changing data, and a plot of the plume and 90% hazard area with automatic scaling. The model has been evaluated using data from over 200 dispersion tests. The report includes a complete technical description, user instructions, the results of the evaluation study, and several sample runs.

**9159 (ADRP—8711) Emission inventory of sulphur oxides and nitrogen oxides in Alberta. Vol. 3. Emission database.** Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Nov 1987. 335p. (MICROLOG—88-00583). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three comprehensive inventories of acid forming emissions in Alberta have been developed: a sulphur dioxide emission inventory, a nitrogen oxides emission inventory, and an inventory of air quality monitoring stations. The inventories are intended to serve as a source of information that will assist investigators in estimating the average rates of NO/sub x/ and SO/sub 2/ emission in Alberta, and the distribution of these emissions by geographic area, industry type, and environmental setting. The inventories will also be useful in predicting changes in emission levels. Administrative information is also provided for each industrial source to facilitate source-specific research. This volume contains the complete computerized printout of the inventories. Only anthropogenic sources are covered, including SO/sub 2/ and NO/sub x/ sources licensed under the Clean Air Act, sour oil batteries with SO/sub 2/ emissions of more than 0.2 tonnes/d, and the following NO/sub x/ sources: industrial engines with a maximum rated power output of over 100 kW, urban centres, and the major portions of high traffic highways. Licensed industrial sources include natural gas processing plants, oil refineries, oil sands/heavy oil recovery facilities, fertilizer and chemical plants, power generation plants, pulp and paper plants, and cement plants. Each source is characterized, as appropriate, with respect to: type of emission, geographic location, environmental setting, physical characteristics, maximum licensed emission rate, and emission characteristics. 6 refs., 6 figs., 19 tabs.

**9160 (ADRP—8711) Emission inventory of sulphur oxides and nitrogen oxides in Alberta. Vol. 2. Design of the emission inventory.** Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Nov 1987. 101p. (MICROLOG—88-00582). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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**9161 (ADRP—8711) Emission inventory of sulphur oxides and nitrogen oxides in Alberta. Vol. 1. Overview of the emission data.** Picard, D.J.; Colley, D.G.; Boyd, D.H. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Nov 1987. 108p. (MICROLOG—88-00581). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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**9162 (ANL/EES-TM—353) Uncertainty data base for emissions-estimation parameters: Area-source supplement to interim report.** Chun, K.C. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Apr 1988. Contract W-31109-ENG-38. 98p. NTIS, PC A05/MF A01 - OSTI. Order Number DE89002991/JAW.

This report deals with the uncertainties associated with estimates of emissions from highway vehicles, which are one of the largest emission-source categories of hydrocarbons (HC) and nitrogen oxides (NO/sub x/) among all area-source categories. It presents the findings from an analysis of (1) uncertainties due to variabilities in the basic test or measurement data that are used in developing emissions-estimation parameters (EEPs) such as emission factors and (2) those due to potential biases that may be introduced in the highway-vehicle emission estimates of HC and NO/sub x/. Such EEPs and emission estimates are used in developing various emissions inventories for the National Acid Precipitation Assessment Program (NAPAP). The categories of emissions test data for which uncertainties due to data variability were analyzed include (1) the basic exhaust emissions test data for HC and its methane component, NO/sub x/, and temperature correction factors for HC and NO/sub x/ and (2) evaporative HC emissions test data. The sources of potential biases examined in the analysis include using annual mean ambient temperatures (instead of hourly temperatures) and using the NAPAP-selected values for vehicle speed and operating-mode distribution in computing the vehicle emission factors. Illustrative examples are presented for estimating the uncertainty that is a result of data variability in estimates of emissions from light-duty gasoline vehicles and for assessing the uncertainty that is due to systematic biases in estimates of emissions from light-duty vehicles. 20 refs., 8 figs., 6 tabs.

**9163 (CONF-881245—1) Accessibility and verification of $CO_2$ emission estimates.** Boden, T.A.; Huang, S.F.; Kanciruk, P.; Nelson, T.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004179/JAW.

From 2. joint conference on integrating data for decision-making; Washington, DC, USA (12 Dec 1988).

The Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) provides $CO_2$-related data in the form of numeric data packages (NDPs) to researchers and policymakers. During compilation of these NDPs, CDIAC thoroughly checks the data and interacts with the contributing researchers and agencies to ensure greater understanding and proper interpretation of the data. During the compilation of a recent NDP, CDIAC collaborated with the United Nations (UN) Energy Statistics Unit to ensure the quality of the UN Energy Data Base. This data base, with more than 310,000 records and 2,000,000 data values, consists of detailed energy production and consumption estimates for all countries from 1950 to 1986. It is essential to the $CO_2$ research program to estimate and predict $CO_2$ emission rates. The resulting data base developed by CDIAC containing global and national $CO_2$ emission estimates shows that the amount of $CO_2$ produced globally from fossil fuel burning and cement manufacturing has risen significantly since 1950. The 1986 global emission estimate of 5.5 gigatons of carbon represents a 4.1% increase over the rate in 1985. 14 refs., 4 figs., 1 tabs.

**9164 (CONF-8807131—1) Broad scale effects of sulfur deposition: A response surface analysis of a complex model.** Hettelingh, J.P.; Gardner, R.H.; Rose, K.A.; Brenkert, A.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002977/JAW.

From Aulanko conference: models to describe the geographic extent and time evolution of acidification and air pollution damage; Alanco, Finland (5 Jul 1988).

Prediction of the broad-scale environmental effects of acid deposition requires the extrapolation of site specific measurements to larger geographical regions. This paper uses Monte Carlo simulation of the RAINS Lake Model to investigate changes in parameter sensitivity and prediction uncertainty for geographic regions which differ in critical soil characteristics and levels of sulfur deposition. Statistical analysis of the results show that: (1) sensitivities and uncertainties shift with regional changes in soil characteristics; (2) simple response surface models can sometimes describe the pattern of predicted sulfur deposition effects; and (3) the degree of fit of the response surface model ($R^2$) indicates the relative homogeneity of response to acid deposition. 31 refs., 8 tabs.

**9165 (DOE/FE/60457—T1) Canadian $SO_2$ and NO/sub x/ emissions study: Final report.** (Sheladia Associates, Inc., Rockville, MD (USA)). May 1988. Contract AC01-84FE60457. 43p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005570/JAW.

The purpose of this report is to examine historic Canadian $SO_2$ and NO/sub x/ emissions trends and emission reduction efforts, current air quality reductions, and future energy needs. Canadian emissions data for 1970 through 1984 were used as the basis for most of the analyses that follow, as they were readily available and this time frame is most relevant to the current acid rain debate. This report is divided into five sections. The first section of the Executive Summary, which presents the report's findings on a point-by-point basis. The second section describes Canadian emissions inventories and emissions estimating methodologies. The third section looks at the sectoral and provincial $SO_2$and NO/sub x/ emissions trends. Canada's air quality programs are addressed in the fourth section. The last section considers Canada's energy outlook, and the implications for future coal consumption especially as a component of Canada's projected electrical generating requirements. 21 refs., 8 figs., 12 tabs.

**9166 (EMR/MR—1988) Derivation of the ventilation recirculation equations relevant to underground dieselized mines.** Dainty, E.D. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.). 1988. 12p. (MICROLOG—88-03389). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Canadian mines operate with the additional considerable expense of mine air heating, usually by propane heaters, during the winter season, to make a suitable workplace. Recirculation of the already heated, used mine air would significantly reduce this expenditure. This can be easily accomplished when the exhaust air

and intake air shafts are located in close proximity to one another. The vertical shafts can be linked with a horizontal heading in which a fan and control equipment can be installed to effect the required recirculation flow. However, in dieselized workings, this means that the recirculated air would contain a level of pollutants. The amount of recirculated air permissible would then depend on the acceptability of the quality of the resulting mix with fresh air that is then directed to the workplace. This report derives expressions relating to the recirculating flow in these circumstances, using the CANMET Air Quality Index (AQI) as the criterion for air quality acceptability. Sample calculations show that a Deutz F6L 912W diesel engine operating at full load/speed continuously in a ventilation stream of 22,100 cfm, produces pollutants which generate an AQI=3 when 27% of the ventilation is recirculated. 1 tab.

9167 **(EUR—10492) Is the detergent of the atmosphere decreasing. Importance of methane for the OH radical concentration and atmospheric photochemistry.** Crutzen, P. (Otto-Hahn-Institut, Mainz (DE)). (Commission of the European Communities, Luxembourg). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756031/JAW.

The field of atmospheric chemistry has developed extremely fast over the last 10-15 years. In the last decade it has been discovered that photochemical reactions are not only important in the stratosphere or higher atmosphere, but also near the ground. Especially ozone in the lower troposphere is important because the whole composition of the troposphere depends on it. The photolysis of ozone gives rise to the OH radical, which is a 'detergent' to the atmosphere. Many compounds would otherwise have much longer lives in the atmosphere and go up to the stratosphere to get decomposed by ultraviolet radiation. Ozone is a very active chemical compound in our immediate environment, life on earth probably would not be the way it is if ozone didn't start a number of reactions. But also methane concentration is increasing in the environment and it's one of the two most important gases which react with the OH radical. In the northern hemisphere methane increased by 1.2% per year over the last 12 years. It has doubled its concentration since the Middle Ages. Its leakage rate from natural gas lines ought to be reduced.

9168 **(KURRI-TR—300) Papers presented at the intensive seminar on 'tree rings'.** Noda, Masato (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Feb 1988. Vp. (In Japanese). (CONF-8708300—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780039/JAW.

From Intensive seminar on tree rings; Kumatori, Japan (24 Aug 1987).

An Intensive Seminar on the use of free rings as an historical monitor of pollution in Japan was held Aug 24 and 25, 1987 at Kyoto University. Selected papers are separately indexed and astracted.

9169 **(LA-UR—88-3316) Field test results of atmospherically dispersed vegetative cells for a tracer using a solar blind fluorescence LIDAR.** Karl, R.R. Jr. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 6p. (CONF-890133—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002051/JAW.

From 6. joint conference on applications of air pollution meteorology; Anaheim, CA, USA (29 Jan 1989).

A solar-blind ultraviolet (uv) LIDAR system has been assembled, tested, and calibrated for the remote detection of atmospherically dispersed biological particles released from an aerosol generator. Fluorescence excited by uv photons and emitted by the aromatic amino acids tryptophan, phenylalamine, and tyrosine indicates the presence of bacterial particles in the cloud. The high fluorescence cross section from 240 to 290-nm excitation results in strong emission in the solar blind region for the vegetative cells of Bacillus globiggi (BG) and Bacillus thuringinesis (BT). These bacteria, both as spores and as vegetative cells, have an absorption ideally located for remote excitation by the powerful, low divergence KrF excimer laser operating at 248 nm. Bacterial proteins have been observed as very dilute atmospheric aerosols to a range slightly greater than 1 km with a single laser shot. In a calibrated field test, we demonstrated detection of 0.3 Bacillus globiggi spore aerosol particles per cubic centimeter of air at a range of 1200 m with a ten-shot signal-to-noise ratio of better than 3:1. Other experiments with the BG and BT vegetative cells at Los Alamos have shown that the vegetative cells have even higher fluorescence cross sections and greater range sensitivities due to their increased size and farther uv shifted fluorescence compared to the spores. 3 figs.

9170 **(LA-UR—88-3341) Ship trail/cloud dynamic effects from Apollo-Soyuz photograph July 16, 1975.** Porch, W.M.; Kao, Chih-yue J.; Kyle, T.G.; Kelley, R.G. Jr. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 15p. (CONF-890134—1). NTIS, PC A03 - OSTI. Order Number DE89002042/JAW.

From Symposium on the role of clouds in atmospheric chemistry and global climate; Anaheim, CA, USA (29 Jan 1989).

We describe in this paper the results of a preliminary analysis of a ship trail photograph taken by the Apollo-Soyuz crew at 22:21 GMT on 16 July 1975. The photograph was taken from an altitude of 174 km and shows three separate ship trails with two of the trails intersecting. Because these photographs were taken from a non-geosynchronous satellite with a high-resolution camera, the quality of the photograph provides more detail than is usually obtained from meteorological satellites (minimum spatial resolution 14 m compared to 57 m from Landsat). The photograph not only shows enhanced detail of the ship trails themselves, but also cloud free bands generated by the ship trails. The ship trails have maximum photographed widths of 3--6 km. These cloud free bands are an obvious indication of the importance of ship trail cloud dynamics to ship trial development. These cloud dynamical effects are driven both by the initial energy release of the ship's power plant and by latent heat release from the aerosol nucleation process. Since the aerosol nucleation process is the key to understanding ocean aerosol/cloud interactions, it is important to partition these two processes in the ship trial development. We will describe in this paper preliminary numerical modeling efforts to simulate the ship trails using only the energy release from the ship and thereby give an indication of how much more energy input may be required from the nucleation process. 12 refs., 6 figs.

9171 **(LBL—26088) Greenhouse gases and global climate change.** Sneider, C.; Golden, R. (comps.). (Lawrence Berkeley Lab., CA (USA)). 15 Jun 1988. Contract AC03-76SF00098. 27p. (CONF-8803166—Summ.). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002957/JAW.

From Workshop on greenhouse gases and global climate change; Livermore, CA, USA (1 Mar 1988).

The workshop on "Greenhouse Gases and Global Climate Change" that was conducted at the Science Education Center, Lawrence Livermore National Laboratory on March 1, 2, and 3, 1988, was the first step in a major effort to develop educational programs on this important topic. This document is a synthesis of the discussions that occurred. Accomplishments were summarized at the conclusion of the workshop by several of its organizers: An alliance of scientists and educators successfully generated a long list of ideas for educational programs in this area. The Workshop resulted in a detailed plan for an educational program. A Group of Advisors for this project has already been formed. The drawing power of the topic, "Greenhouse Gases and Global Climate Change" cannot be overestimated. The ideas described on the following pages will form the basis for a three to five-year project aimed at developing instructional materials on "Greenhouse Gases and Global Climate Change."

9172 **(LUTFD2-TFKF—1011-1-73-1988) Ion beam analytical techniques in atmospheric aerosol studies.** Martinsson, B. (Lund Univ. (Sweden). Dept. of Nuclear Physics). Apr 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755669/JAW.

An ion beam analytical facility has been developed for application to atmospheric aerosol samples. It combines Particle-Induced X-ray Emission (PIXE) and Particle Elastic Scattering Analysis (PESA). Elemental concentrations for elements heavier than silicon are determined with PIXE, with minimum detection limits of the order of 1 ng/cm/sup 2/. Hydrogen, carbon, nitrogen and oxygen are determined with PESA. Minimum detection limits are 100, 15, 10 and 350 ng/cm/sup 2/, respectively. Evaporative losses during

analysis were investigated. The problem mainly applies to the light elements, such as elements present in organic compounds of relatively high saturation vapour pressure. The analytical facility, an external beam setup, allows a helium atmosphere to surround the sample. Quantitative analysis for compounds with saturation vapour pressure below about 10/sup -5/ torr (room temperature) is possible. A method for chemical speciation using multi-elemental ion beam techniques and thermography is presented; Ion Beam Thermography (IBT). Utilizing elemental thermal data and stoichiometry, chemical speciation is obtained. The influence of distant aerosol sources in southern Sweden was investigated using a three-station network. Multivariate statistical evaluation, based on SIMCA, revealed an elemental composition size dependence in the accumulation mode. The results indicate that transformation processes are more important than emission sources for the covariation of sulphur. A technique for the identification of outliers in a data set is presented, which is based on a three-step multivariate statistical evaluation.

9173 **(NP—9770150) Fraunhofer Institute for Toxicology and Aerosol Research. Partial Institute Grafschaft. Annual report 1984.** (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Schmallenberg (Germany, F.R.). Inst. fuer Toxikologie und Aerosolforschung - Teilinstitut Grafschaft). 1985. 184p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE89770150/JAW.

In this progress report 1984 the research projects, the cooperation with other research institutions, and the research reports of the year 1984 are described. Environmental analysis and aerosol research, especially emission analysis (waste gases from automobiles and chimneys), fibrous dusts, release and dispersion of aerosols, furtheron environmental hygiene and inhalation toxicology, development and testing of procedures for the evaluation of environmental chemicals, anthropogenic emissions, air pollution and forest injuries, residential hygiene, protective measures against harmful agents, and miscellaneous special tasks (inhalations, water testing, stimulating allergenic agents) are presented in detail.

9174 **(PB—88-244389/XAB) Review of EPA's (Environmental Protection Agency's) draft Kanawha Valley toxics screening study. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 27 May 1987. 13p. (SAB/EC—87/031). NTIS, PC A03/MF A01.

The Subcommittee unanimously concluded that the Kanawha Valley study represented an important component of EPA's overall effort to develop methodology to define public-health and environmental priorities. Studies such as this provide (1) valuable technical challenges and experiences to EPA staff, particularly to regional offices; and (2) provide a valuable means for developing closer working relationships with state and local officials and the general public. In general, the Subcommittee viewed the Draft Kanawha Valley Toxics Screening Study as one step of a continuing process to assess risks. This study addresses chronic health exposure to carcinogens which represent one of many public-health concerns in the Valley.

9175 **(PB—88-246053/XAB) Testing the validity of the lognormal probability model: computer analysis of carbon monoxide data from US cities.** Ott, W.R.; Mage, D.T.; Randecker, V.W. (Environmental Protection Agency, Washington, DC (USA). Office of Monitoring and Technical Support). Jun 1979. 343p. (EPA—600/4-79/040). NTIS, PC A15/MF A01.

A stratified sample consisting of 11 data sets from an original list of 166 CO air-quality data sets in SAROAD was selected as a national crossection of observed U.S. CO concentrations, along with a longitudinal group of data sets from a single air-monitoring station. The adequacy of the 2-parameter lognormal probability model (LN2) was tested using these data. A special-purpose computer program was developed for calculating the parameters of the LN2 model using four different techniques: (1) direct method of moments; (2) Larsen's method of fractiles; (3) maximum likelihood estimation (MLE) for grouped data using an MLE approximation technique; and (4) MLE for grouped data using computer optimization.

9176 **(PB—88-246111/XAB) Exposure measurement for air-pollution epidemiology.** Ferris, B.G.; Ware, J.H.; Spengler, J.D. (Harvard Univ., Boston, MA (USA). School of Public Health). Aug 1988. 20p. NTIS, PC A03/MF A01.

The chapter describes the evolution of air-pollution epidemiology over a period when changes in pollution technologies have both lowered total exposures and dispersed them over vastly greater areas. Since personal exposure and microenvironmental measurements are expensive, studies oriented toward measurements of total exposure will be smaller and more intensive. The shift in emphasis to total human exposure also will affect health risk assessment and raise difficult issues in the regulatory domain. Considering that outdoor exposures (for which EPA has a regulatory mandate) occur in the context of exposures from other sources, the potential effect of regulatory action would probably be small. The regulatory issues are even more difficult for particulate air pollution since cigarette smoking is the strongest determinant of indoor levels but the EPA lacks regulatory responsibility for cigarette smoke.

9177 **(PB—88-246780/XAB) Air quality criteria for particulate matter and sulfur oxides (1986). Review of the second addendum. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 15 Dec 1986. 6p. (SAB/CASAC—87/009). NTIS, PC A02/MF A01.

See also PB—86-221249.

The 1986 Addendum, along with the 1982 Criteria Document previously reviewed by CASAC, represent a scientifically balanced and defensible summary of the scientific literature on these pollutants. CASAC requested the review of the 1986 Addendum to the 1982 Air Quality Criteria Document on PM/SOx for the purpose of updating the knowledge of recent scientific studies and analyses. Key findings from earlier documents are summarized that provide a reasonably complete summary of newly available information concerning particulate matter and sulfur oxides, with major emphasis on evaluation of human-health studies published since 1981.

9178 **(PB—88-247770/XAB) Methods for reducing exposure to cotton dust. Progress report, 1 January 1981-30 September 1982.** Hersh, S.P.; Batra, S.K. (North Carolina State Univ., Raleigh (USA). School of Textiles). 1982. 12p. NTIS, PC A03/MF A01.

The effectiveness of additives and the blending of fibers on dust emission during carding, the relationship between dust-particle size and grade of cotton, and amount of oil mist in dust from treated cottons were investigated. Six additives were evaluated for dust-suppressant abilities on high-micronaire cotton. A substantial reduction in dust generated was achieved by the addition of very small amounts of five of the additives. For polyester and cotton blends, the dust generated increased as the cotton content of the blend increased and as the production rate increased.

9179 **(PB—88-247796/XAB) Respiratory tract irritants: mechanisms and tolerance. Progress report, 1 October 1971-30 September 1981.** Alarie, Y. (Pittsburgh Univ., PA (USA). Dept. of Industrial Environmental Health Sciences). Nov 1982. 8p. NTIS, PC A02/MF A01.

An animal bioassay system was developed to evaluate airborne chemicals of industrial importance which cause sensory irritation in humans; a model was calibrated for the prediction of safe levels of exposure in industry. This model permitted the evaluation of mixtures of airborne chemicals and could be calibrated to predict human response to such mixtures. The development of tolerance to airborne chemical irritants and the cumulative effects of airborne chemical irritants could be investigated with this bioassay system. The development of a valid animal model for pulmonary hypersensitivity and the application of such findings in workers was initiated. Through the animal bioassay developed, the interaction of inhaled chemicals with DNA can be studied in alveolar macrophages.

**9180 (PB—88-247903/XAB) Health hazard evaluation report, HETA-87-250-1888, GTE Products Corporation, Williamsport, Pennsylvania.** Burr, G.A.; Richardson, F.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1988. 25p. (HETA—87-250-1888). NTIS, PC A03/MF A01.

In response to a request from the Electronic Components Divsion of the GTE Corporation, Williamsport, Pennsylvania, an evaluation was made of possible hazardous working conditions resulting from exposure to rosin pyrolysis products, Freon, methylene chloride, and other chemicals. Workers in the Standard Electronic Module assembly and testing area reported dizziness; headache; eye, nose and throat irritation; memory loss and mood changes. Air sampling was conducted for formaldehyde, total aldehydes, carbon dioxide and carbon monoxide. Medical interviews were conducted with 23 workers; many reported symptoms consistent with exposure to agents with neurotoxic and irritant characteristics. The authors conclude that a potential health hazard existed from inadequate ventilation; chemicals used in the area are capable of precipitating symptoms reported by workers. The authors recommend that measures be taken to reduce or eliminate exposures to methylene chloride, improve housekeeping and ventilation, and institute medical surveillance.

**9181 (PB—88-247945/XAB) Anesthetic metabolism: toxic effects in or personnel. Progress report, 1 June 1977-20 December 1980.** Trudell, J.R. (Stanford Univ., CA (USA)). 1980. 8p. NTIS, PC A02/MF A01.

Studies were conducted on the binding of halothane metabolites to human liver and gonads. Possible metabolism of nitrous oxide was also studied using isotope ratio mass spectrometry and a method of electron paramagnetic resonance spin trapping. A gas chromatograph/mass spectrometry technique was developed to identify and quantify the volatile metabolites of halothane produced in patients and in-vitro incubations. The most toxic metabolite was formed in the patient's breathing circuit, mainly from contact of halothane with hot, wet soda lime. Toxicity and mutagenicity studies indicated that some of the reductive metabolites were moderately mutagenic. Efforts were undertaken to develop a synthetic system in which drug metabolism can be studied using highly purified single forms of cytochrome-P-450 proteins in a membrane environment of exactly defined composition and physical properties. An aim was to ultimately develop a system in which drug toxicity could be tested in human liver cell components without exposing humans to harmful drugs.

**9182 (PB—88-248273/XAB) Industrial-hygiene report: comprehensive survey of wood-preservative treatment facility at International Paper Company, Wiggins, Mississippi.** Todd, A. (Stewart-Todd Associates, Inc., Wayne, PA (USA)). 5 Jan 1980. 27p. (IWS—110.22). NTIS, PC A03/MF A01.

Workers exposures to creosote, and pentachlorophenol (PCP) were determined at the International Paper Company in Wiggins, Mississippi on August 26 and 27, 1980. The survey was part of a NIOSH study of the health effects of occupational exposure to wood preservatives. Approximately 69 of the employees at the facility were assigned to the wood production and treating process areas that were surveyed. The facility maintained an industrial hygiene and safety program. Medical services were provided by an on call physician, a full time facility nurse, and employees trained in first aid. Average PCP concentrations over the full shift ranged from 10.1 to about 25 micrograms per cubic meter, below the current occupational limit of 500 micrograms per cubic meter. Creosote air concentrations ranged from 0.045 to 0.352 micrograms per cubic meter, also below the OSHA standard of 0.2 milligrams per cubic meter. The author concludes that while exposures were below environmental criteria, they could be further reduced by shorting the work operations at the Cellon process. He also recommends minimizing skin contact and absorption from contaminated clothing.

**9183 (PB—88-248422/XAB) Asbestos removal or treatment in Oklahoma schools. Progress report, 1 June 1980-31 May 1981.** Martin, B. (Oklahoma State Dept. of Education, Oklahoma City (USA)). 1981. 6p. NTIS, PC A02/MF A01.

A program was developed to provide as much correct information as possible to the public schools in Oklahoma concerning asbestos removal or treatment in their buildings. The problem buildings were identified early in the program and ten workshops were conducted on this topic. Workshops were designed to be 3 hours in length. The first workshop was held in July of 1980 with 73 districts sending representatives. Much literature was distributed at the workshop meetings. By April of 1981, 15 of the districts had completely corrected their asbestos problems. A list of 11 asbestos abatement contractors servicing Oklahoma were identified; some were trained at the workshops. All contractors were sent materials concerning recommended and required procedures to be followed. The names of three air sampling laboratories were given to the schools.

**9184 (PB—88-248430/XAB) Bidding documents for asbestos abatement in Oklahoma public buildings.** Martin, B.; Hodges, J.; Hallett, P.; Myers, B. (Oklahoma State Dept. of Education, Oklahoma City (USA)). Mar 1981. 59p. NTIS, PC A04/MF A01.

The publication contained the necessary forms and requirements for those bidding for asbestos removal projects in public buildings in Oklahoma. Included were the solicitation for bids form, and information concerning the contracting of labor for the treatment of friable asbestos-containing material. The information concerned requirements for site examination, rejection of bids, stipulations to be followed in awarding the contract, general clean-up rules, methods of laying out the work, use of temporary utilities, prevailing wage scale, liquidated damages, required bonds and affidavits, completion and final payment, liability insurance, property insurance, and other contractor obligations. A sample contract was included along with samples of work orders, statutory bonds, performance bonds, defect bonds, bid affidavits, claim or invoice affidavits, notifications, disposal permits, pertinent extracts from the Asbestos Control Act of 1980, copies of sections of the U.S. Department of Labor/Occupational Safety and Health Administration Asbestos Regulations, and copies of relevant Environmental Protection Agency regulations.

**9185 (PB—88-248505/XAB) Control of emissions from municipal solid-waste incinerators. Final report.** DePaul, F.T.; Crowder, J.W. (DePaul and Associates, Inc., Highland Park, IL (USA)). Jul 1988. 289p. NTIS, PC A13/MF A01.

This report was prepared to identify those municipal solid-waste-incineration emissions that pose the greatest potential human-health risks and to document which existing control scenarios have the best demonstrated performance in reducing these emissions. The information is presented in an effort to facilitate BACT determinations for these sources. A survey of state air toxic regulations was undertaken to determine the impact of health-based regulations on MSW incinerator emissions and to help identify the pollutant emissions of greatest concern. The pollution-control scenarios are presented and discussed. Information on uncontrolled and controlled emissions was collected for 61 incineration facilities, encompassing mass burn, starved air, and RDF-fired combustion technology. Data were analyzed to determine expected emissions levels for both criteria and non-criteria pollutants, and to determine expected control levels. Data on the cost of control equipment for each type of combustor are included.

**9186 (PB—88-248695/XAB) Walk-through survey, St. Mary's Carbon Company, St. Mary's, Pennsylvania, March 4, 1983.** Greife, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Mar 1983. 12p. (IWS—142.13). NTIS, PC A03/MF A01.

A walk-through survey was conducted at St. Mary's Carbon Company St. Mary's, Pennsylvania, in March 1983. The company produced carbon-replacement automotive parts such as brushes, seals, and rings. The raw materials used were petroleum coke and coal tar pitch. Preemployment physicals were given to all employees, but did not include pulmonary-function or hearing tests, or chest x rays. Periodic medical examinations were not given, and no nurse was employed. Several employees were trained in first aid. Engineering modifications were made to decrease employee exposure to airborne contaminants. All machinery in the finishing areas was equipped with permanent ventilation equipment. Hoods were

installed for kiln graphitizing furnaces. Canopy type hoods were installed above heated rotary mixers in the mixing department. A stationary ventilation duct was installed in the assembly department. Dilution ventilation was used throughout most of the facility. The author concludes that the extent of employee exposures to polyaromatic hydrocarbons should be assessed and by-products of soldering and welding operation should be evaluated.

9187 **(PB—88-248786/XAB) Industrial-hygiene survey report at Reynolds Aluminum Company, Longview, Washington, August 28-30, 1978.** Bloom, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Jul 1981. 23p. (IWS—38.23A). NTIS, PC A03/MF A01.

See also PB—82-110065.

A survey to determine exposure to selected polynuclear aromatic hydrocarbons (PAH) was conducted at Reynolds Aluminum Company, Primary Metals Division in Longview, Washington on August 28-30, 1978. A total of 1030 production employees were located at the north and south facilities. Particulates in samples for total particulates, chrysene, pyrene, fluoranthene, benz(a)anthracene, and benzo(a)pyrene ranged from less than 0.04 to 0.83 milligrams per cubic meter, and less than 0.35 to 9.40, less than 0.28 to about less than 3.5, less than 0.06 to 0.88, less than 0.20 to 5.20, and 0.35 to 4.90 micrograms per cubic meter, respectively, in both facilities. Corresponding concentration ranges detected in vapor form were 0.06 to 0.21 milligrams per cubic meter and less than 0.14 to 1.30, less than 0.36 to 6.90, 1.40 to 12.00, less than 0.13 to 1.20, and less than 0.10 to 1.50 micrograms per cubic meter, respectively. Total nuisance-dust and respirable-dust concentrations ranged from 1.33 to 5.86 and 0.15 to 5.11 milligrams per cubic meter, respectively.

9188 **(PB—88-248802/XAB) Industrial-hygiene survey of Aerovox Industries, Inc., New Bedford, Massachusetts, March 21-23, 1977.** Phillips, B.; Smith, L.; Jones, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1977. 20p. (IWS—95.14). NTIS, PC A03/MF A01.

An industrial-hygiene survey was conducted at Aerovox Industries, Incorporated, New Bedford, Massachusetts, in March 1977 to collect data on worker exposures to polychlorinated biphenyls, soldering fumes, and trichloroethylene. The survey was conducted on behalf of 350 employees (300 involved in the production processes), including 104 having potential exposure to polychlorinated biphenyls. A physician was retained on a part-time basis, and the company employed a full-time nurse. Preemployement physical examinations including pulmonary function tests were given to employees. Detector tubes were used to determine trichloroethylene; concentrations rarely exceeded 100 parts per million (ppm). Personal protection included safety glasses, rubber clothing, barrier creams, and partial payment for safety shoes. Trichloroethylene concentrations ranged from 53.4 to 77.5 ppm with an OSHA standard of 100 ppm. Polychlorinated biphenyls ranged from 0.17 to 1.26 milligrams per cubic meter (mg/m$^3$) with an OSHA standard of 1mg/m$^3$. The authors conclude that the standard for polychlorinated biphenyls may not be adequate to protect worker health. Recommendations are given.

9189 **(PB—88-248828/XAB) Survey report, Armstrong Cork Company, Lancaster, Pennsylvania, May 11, 1977.** Dement, J.M.; Robinson, C.; Ludwig, H.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1977. 6p. (IWS—83.10). NTIS, PC A02/MF A01.

The Armstrong Cork Company, Lancaster, Pennsylvania, was investigated to assess potential health hazards and medical problems. The survey was limited to the finishing department and one tile department, where methylene-bis-4-cyclohexylisocyanate was used as a coating compound. There were 8 to 12 cases of dermatitis reported in a given year. No cases of isocyanate sensitization were reported. No emergency spill procedures were posted in any of the finishing areas. No medical monitoring was provided to workers in the area. Ventilation for the coater process was extremely poor. No protective clothing was worn by workers handling the coated tiles. Odors were especially strong. Open buckets of solvent were observed, and no protective clothing or respiratory protection was required. NIOSH recommends that ventilation on the coater and heating kettle be improved. It also suggests that emergency spill-cleanup procedures be posted and all solvent containers be covered. All provisions in the NIOSH Diisocyanate Criteria Document should be followed, including those for medical examinations.

9190 **(PB—88-248851/XAB) Walk-through survey report, International Harvester-Fort Wayne, Ft. Wayne, Indiana, December 6, 1978.** Zaebst, D.; Haring, M. (Johns Hopkins Univ., Baltimore, MD (USA)). Jul 1979. 13p. NTIS, PC A03/MF A01.

Worker exposures to painting materials were studied at International Harvester, Fort Wayne in Fort Wayne, Indiana, on December 6, 1978. The company was under consideration for inclusion in a NIOSH study of health hazards in the painting industry. Approximately 118 of the employees of the facility were assigned to the painting operations surveyed. The company had a safety and industrial-hygiene program. Medical services were furnished by 4 inhouse dispensaries with 4 part-time physicians, 10 full-time nurses and 2 full-time x-ray technicians. Personnel records provided demographic information and absence reports. The major types of paints utilized at this facility included flow coat and electroclip primers, and thermosetting acrylic enamels or two component polyurethane finish paints. The authors conclude that this facility would be suitable for an indepth industrial hygiene survey, as well as for an epidemiological study.

9191 **(PB—88-248877/XAB) Survey for n-nitroso compounds at Mohawk Tannery, Nashua, New Hampshire, October 12, 1978.** Fajen, J.; Egan, B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1978. 14p. (IWS—72.29). NTIS, PC A03/MF A01.

Air samples were collected on October 12, 1978 at the Mohawk Tannery in Nashua, New Hampshire, to determine the presence of N-nitroso compounds. N-nitrosodimethylamine (NDMA) was found in most air samples in concentrations ranging from 0.01 to 8 micrograms per cubic meter (micrograms/cu m). The greatest amounts of NDMA were found in the loft above the unhairing process. The authors conclude that NDMA is formed from an artifact in one or more of the wet tanning operations, or is present as a contaminant in one or more of the materials used in these operations. They suggest that the retanning, coloring, and fatliquoring processing area is the most likely place for the production of NDMA, or the point where it may be introduced as a contaminant.

9192 **(PB—88-248885/XAB) Survey for N-nitroso compounds at Lipman Marine Products, Incorporated, Gloucester, Massachusetts, October 4, 1977. Final report.** Krull, I.; Young, R. (Thermo Electron Corp., Waltham, MA (USA). Research and Development Center). Jan 1978. 25p. NTIS, PC A03/MF A01.

An industrial-hygiene survey to determine the extent of exposure to N-nitroso compounds at the fish-meal production facility, Lipman Marine Product, Gloucester, Massachusetts, is reported. Bulk sample of the whole raw-fish and fish-meal production were obtained. Six area air samples were also collected. No significant levels of volatile n-nitrosamines were found in the fresh raw-fish samples analyzed. In the final fish-meal product there were observable amounts of N-nitrosodimethylamine (NDMA) and other triethanolamine positive materials. Data from air-sampling indicate the presence of significant levels of NDMA at several sites within the factory.

9193 **(PB—88-248893/XAB) Survey of Goodyear Tire and Rubber Company, St. Marys, Ohio, February 9-10, 1976.** Johnson, P.; Rinsky, R.; Infante, P.; Jones, M.; Young, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1976. 14p. (IWS—61.10). NTIS, PC A03/MF A01.

Worker exposure to benzene vapors and noise were surveyed at Goodyear Tire and Rubber Company, Cast Film Division in St. Marys, Ohio, on February 9 and 10, 1976. The company was

under consideration for inclusion in an epidemiological study of the health effects of benzene exposure. The division manufactured clear-plastic polyvinyl chloride and rubber hydrochloride films using the solvent casting method. Three shifts were worked 5 or 6 days per week, and 10 employees were assigned per shift. The company had a corporate medical director, a consultant, and a nurse for monthly examinations of workers with benzene exposure. The company had industrial health and safety programs and provided personal-protection equipment. Twenty breathing-zone samples collected for benzene ranged from 3.78 to 47.80 parts per million (ppm), and the 8 hour weighted average ranged from 7.18 to 24.91 ppm. The authors recommended that benzene exposure be limited to 1 ppm collected at the rate of 1 liter per minute for 2 hours. They conclude that an epidemiologic evaluation of mortality patterns should be conducted at this facility.

9194 **(PB—88-249347/XAB) Industrial-hygiene report, walk-through survey, papaya packing/shipping facilities, Hilo, Hawaii, July 1983.** Clapp, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1983. 27p. (IWS—64.17.10). NTIS, PC A03/MF A01.

Worker exposure to ethylene dibromide (EDB) was investigated at three papaya packing and shipping facilities in Hilo, Hawaii. Breathing-zone samples were collected in the three facilities over a three day period. Blind spikes were submitted as a control on time and temperature effects. Blank samples were also prepared. Spike results reflected the effects of time and temperature in shipment from Hawaii to Massachusetts. All spikes were roughly comparable and showed a recovery of about 68%. Overnight laboratory results were adjusted upward by 72% and NIOSH laboratory results by 68%. Six out of 38 samples exceeded the NIOSH recommended amount of 130 ppb. The author concludes that there is a chronic, low-concentration exposure to EDB for all workers in the papaya industry in Hilo. An epidemiological study of reproductive and cytogenetic effects of EDB exposure on these workers is recommended.

9195 **(PB—88-249354/XAB) GCA respirable-dust monitor field trial, Barne, Vermont, November 5-14, 1973.** Wallingford, K. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Field Studies and Clinical Investigations). Feb 1974. 18p. (IWS—30.01). NTIS, PC A03/MF A01.

Respirable-dust measurements taken by a GCA respirable-dust monitor were compared to those taken by a standard-mass respirable sampling system (MSA). Air samples were collected at three granite sheds in Barne, Vermont, where finished monuments were produced. MSA pumps were run 7 to 8 hours per day, and GCA readings were taken from 1- to 8-minute sampling periods within 1- to 2-hour intervals. Average respirable-dust concentrations measured MSA in sheds A, B, and C were 0.373, 0.374, and 0.536 milligrams per cubic meter (mg/cu m), respectively. Corresponding readings taken by the GCA, were 0.619, 0.589, and 0.741 mg/cu m. The three major problems encountered with the GCA were the 10-millimeter nylon cyclone. The authors suggest that the higher GCA readings, compared to MSA measurements, may be related to the cyclone malfunction; the GCA monitor is designed to operate at a flow rate of 2.0 liters per minute.

9196 **(PB—88-249362/XAB) Walk-through survey report, American Hoist and Derrick Company, St. Paul, Minnesota, January 16, 1979.** Billings, C.; Lazar, C. (Johns Hopkins Univ., Baltimore, MD (USA). Hospital). Nov 1979. 38p. (IWS—74.34). NTIS, PC A03/MF A01.

Worker exposures to paint materials were studied at the American Hoist and Derrick Company in St. Paul, Minnesota, on January 16, 1979. The company was under consideration for inclusion in a NIOSH study of health hazards in the painting trade. Approximately 12 of the employees at the facility were assigned to the painting operations surveyed. The company had a safety and industrial-hygiene program. Medical services were provided by a part-time physician and a full-time nurse. Personnel records furnished demographic information, department assignments, and medical data. Solvent-based chromate primers, alkyds, and urethanes were routinely used in painting operations. The total coatings and solvents used were 19,700 gallons in 1978. The authors conclude that the work force should be considered for inclusion in the painting-hazard survey, although the small number of painters in the work force makes the facility inappropriate for an in-depth epidemiological study.

9197 **(PB—88-249370/XAB) Walk-through survey report, Barber-Greene Company, Aurora, Illinois, December 12, 1978.** Matanoski, G.; Whitman, N. (Johns Hopkins Univ., Baltimore, MD (USA). Hospital). Jul 1979. 27p. (IWS—74.45). NTIS, PC A03/MF A01.

Worker exposures to paints and solvents were examined at the Barber-Greene Company in Aurora, Illinois, on December 12, 1978. The company was under consideration for inclusion in a NIOSH study of health hazards in the painting industry. Approximately 41 of the employees at the facility were assigned to the painting-operations area surveyed. The company had no formal safety and industrial-hygiene program. Medical first-aid services were provided by a resident nurse and industrial-hygiene services were furnished by an insurance company on a request basis. Personnel records provided demographic information and work positions. The authors conclude that due to the small number of employees exposed to paint vapors and mists at the facility, an in-depth industrial-hygiene study is not applicable. They recommend that the facility be considered for further studies in view of the type of painting operations employed at the facility.

9198 **(PB—88-249388/XAB) Walk-through industrial hygiene survey, Levi-Strauss and Company, Blackstone, Virginia, October 25, 1974.** Nord, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1974. 10p. (IWS—46.30). NTIS, PC A02/MF A01.

Worker exposure to total airborne dust, noise, and light measurements were surveyed at Levi Strauss and Company in Blackstone, Virginia on December 9, 1974. The company employed 300 production and 100 indirect workers on a single daily shift. Formerly the factory was manufacturing pants, but it was converting to the manufacture of outer shirts made from polyesters, rayons, and cotton-blended fabrics at the time of the survey. There was no medical program and industrial hygiene, and safety programs were handled at the divisional levels. No physician, nurse, or clinic was provided, health information for new employees was regularly recorded, and they were required to take a medical examination. Noise levels ranged from 72 to 93 decibels. Illumination levels in sewing areas were 42 footcandles (fc) and auxiliary illumination on sewing machines was 300 fc. Airborne-dust concentrations were 0.11 milligrams per cubic meter (mg/CuM) with fiber diameters ranging from 3 to 20 microns. The fiber length was 727 microns. No chemicals or solvents were used. The author notes that workers exposed to 85 decibels or more for over 8 hours must have routine audiograms under the proposed OSHA standards. They recommended the use of safety glasses of optical quality to replace plastic eye shields on the button sewing machines and pulmonary-function tests for workers exposed to dusts from chemically treated fabrics.

9199 **(PB—88-249750/XAB) Industrial-hygiene walk-through survey report of E. I. duPont deNemours and Company, Pontchartrain Works, Laplace, Louisiana, August 26, 1985.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Apr 1986. 20p. (IWS—147.31). NTIS, PC A03/MF A01.

A walk-through survey was conducted at E. I. duPont deNemours and Company, LaPlace, Louisiana, August, 1985. The purpose of the survey was to obtain information on the neoprene polymer production process and to evaluate the potential for exposure to 1,3-butadiene. Bulk samples of neoprene were analyzed for residual 1,3-butadiene. The facility produced hydrogen-chloride and chloroprene as marketable products as well as neoprene. The process occurred in a closed system, tightly maintained for economic and fire-hazard reasons. Single mechanical seals were used on all 1,3-butadiene pumps. Quality control sampling was done using gas bags in the tank farm. No residual 1,3-butadiene was found in the bulk neoprene samples. The company reported they had conducted air monitoring for 1,3-butadiene and found most exposures to be below 10 parts per million. Personnel records on current and termi-

nated employees were maintained. A total of 1,264 workers had worked at the facility. The authors conclude that the facility should be considered a candidate for an in-depth survey. The company should consider retrofitting dual mechanical seals on all process pumps with single mechanical seals.

9200 **(PB—88-249800/XAB) Dow Chemical Building 703 incinerator exhaust and ambient air study. Final report.** Trembly, M.G.; Amendola, G.A. (Environmental Protection Agency, Chicago, IL (USA). Region V). Mar 1987. 308p. (EPA—905/4-88/004). NTIS, PC A14/MF A01.

The purposes of this study were: (1) determine the levels of dioxins and other toxic compounds in ambient air near the Dow Chemical Midland plant; and (2) determine the levels of dioxin and other chemicals in the Building 703 incinerator exhaust gas, wastewater, and ash, under normal operating conditions. The ambient air study included positive findings of low levels of dioxins at air monitoring sites near the plant fence line and at the site located in the city, ranging up to 0.0004 ug/m$^3$ for the less-toxic forms. The study concluded there were no readily observable relationships between the incinerator temperature, pressure, air-pollution control device and flow rates, and the levels of certain dioxins found in the exhaust during the three days of testing. However, there may be a relationship between the levels of dioxin fed into the incinerator and the levels of dioxin discharged.

9201 **(PB—88-249818/XAB) Risk assessment for dioxin contamination at Midland, Michigan (second edition). Final report.** Nisbet, I.C.T.; Mendez, W.M.; Phillips, W.; Barnes, D.G. (Environmental Protection Agency, Chicago, IL (USA). Region V). Apr 1988. 220p. (EPA—905/4-88/005). NTIS, PC A10/MF A01.

Results are presented of a comprehensive, multi-media, human-health risk assessment of the contamination in the Midland, Michigan, area with 2,3,7,8-tetrachlorodibenzo-p-dioxin, or TCDD, and related compounds (dioxin) resulting primarily from past releases from the Dow Chemical Company's Michigan Division plant. The risk assessment follows USEPA's published guidelines for carcinogen risk assessment and exposure assessment. An exposure-assessment section summarizes the available environmental-monitoring data for the Midland area and derives estimated human intakes of dioxin for a number of scenarios based upon exposure of the local population to ambient air, drinking water, soil, and fish. Finally, a risk-characterization section combines the dose response and exposure information to determine estimated probabilities of adverse health effects for the scenarios considered.

9202 **(PB—88-249859/XAB) Organic emissions from consumer products and building materials to the indoor environment.** Tichenor, B.A.; Mason, M.A. (Acurex Corp., Research Triangle Park, NC (USA)). 1988. 7p. NTIS, PC A02/MF A01.

Pub. in JAPCA, Vol. 38, No. 3, 264-268(Mar 1988). See also PB—87-191839.

This paper discusses EPA studies in small environmental test chambers on a variety of building materials and consumer products. A number of test conditions are critical in effectively determining emission rates (e.g., temperature, humidity, air-exchange rate, and product loading--area of sample/volume of test chamber). In addition, the effects of chamber concentration and chamber wall effects (i.e., adsorption to and desorption from surfaces) need to be determined. Finally, the age and condition of the sample affect its emission rate. All of these variables and phenomena are considered in the EPA research program.

9203 **(PB—88-250170/XAB) Industrial-hygiene survey at the Kaiser Aluminum Company, Tacoma, Washington. Industry-wide study.** Larsen, L.B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1973. 26p. (IWS—38.27). NTIS, PC A03/MF A01.

Worker exposures to coal tar pitch volatiles, fluorides, carbon monoxide, and sulfur dioxide were surveyed on May 3-6, 1973, at Kaiser Aluminum in Tacoma, Washington. The number of employees was not reported. Total particulate concentrations ranged from 0.1 to 21.7 milligrams per cubic meter (mg/CuM), while the concentration of benzene-soluble materials ranged from 0.1 to 1.4mg/CuM. Total fluoride concentrations were 0.1 to 0.9mg/CuM. Carbon monoxide concentrations ranged from below 50 parts per million, and sulfur dioxide was undetectable. The authors note that compliance with legal exposure standards should be used on samples collected by the company and the government agency responsible for compliance enforcement.

9204 **(PB—88-250261/XAB) Emissions of air pollutants from indoor materials: an emerging design consideration.** Tucker, W.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 16p. (EPA—600/D-88/191). NTIS, PC A03/MF A01.

This paper discusses the importance of indoor air quality in the acceptability of a building. The health and productivity of building occupants can be affected by the presence of certain organic chemical vapors, particles, and biological contaminants in the indoor air. Many of the materials used in buildings, either as structural materials or furnishings, or contents such as work supplies and maintenance materials, can be sources of indoor air contaminants. Concepts on material evaluation and selection are presented.

9205 **(PB—88-250279/XAB) Air pollutants from surface materials: factors influencing emissions, and predictive models.** Tucker, W.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 15p. (EPA—600/D-88/180). NTIS, PC A03/MF A01.

This paper gives an overview of the state of knowledge of emissions from surface materials, the factors that influence those emissions, and models that can be used in evaluating emissions data. It concludes by focusing on indoor air-quality control by controlling emissions, especially by producing and using low-emitting materials.

9206 **(PB—88-250311/XAB) Historic volatile organic compounds (VOCS) emissions estimates and activity data (for microcomputers). Data file.** Mobley, J.D.; Gschwandtner, G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 31 Mar 1988. vp. NTIS CP D03.

See also PB—88-189022, PB—88-157888, and PB—83-195511; The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC, XT microcomputer. The diskettes are in the LOTUS 1-2-3 format.

Lotus spreadsheets containing the data presented in Appendix B of the EPA report Historic Emissions of Volatile Organic Compounds (VOC) in the United States from 1900 to 1985 are provided on three 5 1/4 floppy diskettes. VOC emissions and activity data are given for the United States; Alabama-Florida; Georgia-Louisiana; Maine-Montana; Nebraska-North Dakota; Ohio-Tennessee; and Texas-Wyoming. The data file is in the LOTUS 1-2-3 format using the DOS 3.10 operating system.

9207 **(PB—88-250360/XAB) Total human exposure and indoor air quality: an automated bibliography (BLIS) with summary abstracts. Final report.** Shackelford, J.M.; Ott, W.R.; Wallace, L.A. (SRA Technologies, Inc., Alexandria, VA (USA)). May 1988. 466p. NTIS, PC A20/MF A01.

The Bibliographic Literature Information System (BLIS) is a computerized data base with brief abstracts that comprehensively reviews literature on total human exposure to environmental pollution. Unpublished draft reports are listed, as well as final reports of the U.S. Government and other countries, reports by governmental research contractors, journal articles, and other contributions. The bibliography covers publications on exposure models, new field data, and newly emerging research methodologies. Although the bibliography covers the entire field of human-exposure methodology, emphasis is on those field studies measuring all the concentrations to which people may be exposed, including indoors, outdoors, or in-transit. Versions of the data base are available on floppy diskettes that can be accessed on MS-DOS computers with two-floppy-disk or hard-disk systems.

9208 **(PB—88-250444/XAB) Results of air samples at Certain-Teed Products, Santa Clara, California. Industrywide study.** Lynch, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1968. 16p. (IWS—32.42A). NTIS, PC A03/MF A01.

Worker exposures to asbestos were surveyed at a company in Santa Clara, California. Impinger samples from the mixing, forming, curving, pipe finishing, coupling finishing, and epoxy areas contained 0.2 to 2.4, 1.0 to 2.8, 0.8 to 2.7, 1.2 to 3.8, 1.3 to 23.7, and 2.0 million particles per cubic foot (mppcf), respectively. Several samples from the finishing area exceeded the threshold limit value (TLV) of 5 mppcf. Corresponding asbestos concentrations determined by the membrane-filter method were 0.8 to 19.6, 0.3 to 8.7, 0.6 to 3.1, 2.1 to 11.5, 2.3 to 33.4, and 1.8 to 3.5 fibers greater than 5 microns per cubic centimeter (f/cc). In the packing area, membrane-filter samples indicated asbestos concentrations of 0.1 to 8.6 f/cc. No standards existed for evaluating membrane-filter samples, however, concentrations greater than 10.0 f/cc over a 3 month period were considered high.

9209 **(PB—88-250451/XAB) Results of air samples at American Asbestos Textile Corporation, Meredith, New Hampshire. Industrywide study.** Lynch, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1966. 8p. (IWS—32.15B). NTIS, PC A02/MF A01.

See also PB—82-100652.

Worker exposures to asbestos were surveyed at the American Asbestos Textile Corporation in Meredith, New Hampshire, June 21, 1966. Asbestos-fiber concentrations in the fiber preparation, carding, spinning, twisting, winding, weaving, finishing, and rope, wick, braid and cord areas were 6.0 to 17.1, 14.8 to 118.6, 7.4 to 26.2, 5.6 to 15.1, 4.3 to 27.0, 5.8 to 35.9, 7.5, and 6.3 to 7.4 fibers greater than 5 microns per cubic centimeter, respectively.

9210 **(PB—88-250469/XAB) Industrial-hygiene survey at Johns-Manville Products Division-Textiles, Manville, New Hersey. Industrywide study.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1973. 7p. (IWS—32.22E). NTIS, PC A02/MF A01.

See also PB—82-162520.

Asbestos exposures at a Johns-Manville textiles production company were measured. Forty-seven individual measurements were presented, ranging from 0.1 to 3.4 fibers per cubic centimeter. All samples were below the threshold limit value of 5.0 fibers per cubic centimeter.

9211 **(PB—88-250477/XAB) Survey for N-nitroso compounds at B. F. Goodrich, Woodburn, Indiana, December 12, 1979. Industrywide survey.** Ringenburg, V.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 28 Feb 1980. 11p. (IWS—72.36). NTIS, PC A03/MF A01.

Worker exposures to N-nitroso compounds were evaluated at B.F. Goodrich Company, Woodburn, Indiana on December 12, 1979. Personal and area air samples were collected and analyzed by gas-chromatography and thermal-energy-analysis methods. All of the samples contained N-nitrosomorpholine (NMOR) and five samples also contained N-nitrosodimethylamine (NDMA). The amount of NMOR ranged from 0.85 to 3.7 micrograms per cubic meter (micrograms/cu m) for area air samples and 0.63 to 1.8 micrograms/cu m for personal samples. NDMA concentrations ranged from undetectable to 1.8 microgram/cu m for area samples and undetectable to 0.09 micrograms/cu m for personal samples. The authors note that no exposure standards exist for NDMA or NMOR but both are listed as potential human carcinogens. They suggest that the B.F. Goodrich Company characterize nitrosamine exposures at this facility.

9212 **(PB—88-250485/XAB) Walk-through survey report of Amana Refrigeration, Inc., Amana, IA, February 14, 1979. Industrywide survey.** Billings, C.; Lazar, C. (Johns Hopkins Univ., Baltimore, MD (USA)). 16 Jul 1979. 23p. NTIS, PC A03/MF A01.

Worker exposures to paint materials were studied at Amana Refrigeration, Incorporated, in Amana, Iowa, on February 14, 1979. The company was under consideration for inclusion in a NIOSH study of the health hazards in the painting trade. Approximately 35 of the employees at the facility were assigned to the painting operations surveyed. The company had a formal safety and industrial-hygiene program. Medical services were furnished by two consulting physicians and three nurses. Personnel records provided demographic information, department assignments, and absence reports. Some paint-overspray release from the linear prime paint booth was noted, and solvent odors were detected in two Ransberg painting booths. The authors recommend that this work force be considered for inclusion in the painting-hazards survey, although they caution that an epidemiological or medical study would be hindered by the small number of painters, difficulties in locating previous workers, and the incompleteness of the company's records.

9213 **(PB—88-250816/XAB) Pulse energization in the tuft-corona regime of negative corona.** Plaks, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jan 1988. 7p. (EPA—600/J-88/050). NTIS, PC A02/MF A01.

Pub. in the Proceedings of the Institute of Electrostatics Japan, Vol. 12, No. 1, 43-47(Jan 1988).

The paper discusses pulse energization in the tuft-corona regime of negative corona. Fabric filtration, with integral particle charging and collection in a combined electric and flow field, is sensitive to maldistribution of current among bags energized by one power source, especially when operating in the tuft-corona regime below glow-corona onset. Pulse energization superimposed on the direct current (DC) applied to the bags tends to equalize the currents. The currents are also equalized by misalignment. However, the misalignment could cause sparking at lower applied voltages. Pulse energization in the tuft-corona regime could also be useful in electrostatic precipitators (ESPs) if misalignment is mild.

9214 **(PB—88-251541/XAB) Walk-through survey report, Courtaulds North America, Inc., Mobile, Alabama, July 21-22, 1977.** Jones, J.H.; Selevan, S.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1977. 5p. (IWS—75.16). NTIS, PC A02/MF A01.

A walk-through survey was conducted at Courtaulds North America, Inc., Mobile, Alabama on July 21-22, 1977. The purpose of the survey was to evaluate the factory for possible inclusion in a NIOSH study on the medical and reproductive effects of carbon disulfide ($CS_2$) exposure. The viscose rayon work force consisted of 750 production workers, and all but one were males. The average age was 42, and 80 to 85% were married. The factory was surveyed periodically for $CS_2$ vapors, and samples were analyzed by spectrophotometry. Concentrations of $CS_2$ ranged from 0 to 75 parts per million (ppm) in operating areas; average concentrations ranged from 4 to 20 ppm. Personal breathing-zone samples ranged from 1 to 57 ppm, with averages from 4 to 15 ppm. Employees received annual blood profiles, pulmonary function tests, audiometric tests, and vision tests. In 1 year, there were 28 lost work-day injuries. The operations reported to have the greatest $CS_2$ exposure during the industrial process were spinning and cutting. The churning and mixing operations were also expected to produce $CS_2$ vapors. However, those operations were never monitored. NIOSH concludes that potential health hazards at the factory include exposure to carbon disulfide, hydrogen sulfide, noise, sodium-hydroxide, and sulfuric acid.

9215 **(PB—88-251558/XAB) Walk-through survey report, Ford Motor Company, Los Angeles Assembly Plant, Pico Rivera, California, January 30, 1979.** Matanoski, G.; Whitman, N. (Johns Hopkins Univ., Baltimore, MD (USA). Hospital). Jul 1979. 23p. (IWS—74.52). NTIS, PC A03/MF A01.

Worker exposures to painting materials were studied at the Ford Motor Company, Los Angeles Assembly Facility in Pico Rivera, California on January 30, 1979. The company was under consideration for inclusion in a NIOSH study of health hazards in the painting trade. Approximately 99 of the employees at the facility were assigned to the painting operations that were surveyed. The company had a safety and industrial hygiene program. Medical

services were furnished by one full-time physician and three nurses. Various types of paint primers, solvents, and enamel paints were used during painting operations. The authors recommend that the facility be considered for the painting-hazards study.

9216 **(PB—88-251574/XAB) Walk-through survey report, Henredon Furniture Industries, Morgantown, North Carolina, August 2, 1978.** Matanoski, G.; O'Toole, J.; Lees, P. (Johns Hopkins Univ., Baltimore, MD (USA). Hospital). Aug 1978. 13p. (IWS—74.14.10). NTIS, PC A03/MF A01.

See also PB—85-107597.

A walk-through survey was conducted at Henredon Furniture Industries, Inc., in Morganton, North Carolina on August 2, 1978, to determine whether this site would be suitable for inclusion in an epidemiological, industrial-hygiene, and medical survey of health hazards in the painting trades. The facility employed 785 workers, 110 of whom worked in finishing operations. An industrial nurse was present at the facility. Pre-employment physicals were not required but audiometric examination were given to employees. Splinters and contusions were the most common accidents. The company had a safety program and committee but no industrial-hygiene program. Spraying operations were conducted in spray booths. Clear lacquers, pigmented lacquers, glazes, stains, and sealers were used. Large quantities of finishing materials were used on a continuous basis. The authors recommend the facility for further industrial-hygiene, epidemiologic, and medical surveys.

9217 **(PB—88-251640/XAB) Plume diffusion in a residential neighborhood during stable conditions. Interim report.** Lamb, B.; Allwine, E.; Eskridge, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1988. 7p. (EPA—600/D-88/184). NTIS, PC A02/MF A01.

As part of the EPA Integrated Air Cancer Program, a series of atmospheric tracer releases was conducted to investigate plume dispersion under wintertime, nighttime conditions in an urban valley as a basis for determining the relative impact of nearby and far-away sources upon air-quality-monitoring sites. Hourly averaged diffusion rates exceeded typical rural diffusion rates by more than two stability classes and the McElroy-Pooler urban diffusion curves by one stability class. Horizontal diffusion rates estimated from turbulence data measured at the source agreed within 38% of the observed diffusion rates over distances of less than 1 km.

9218 **(PB—88-251657/XAB) Compensating for sink effects in emissions test chambers by mathematical modeling. Report for June 1986-February 1987.** Dunn, J.E.; Tichenor, B.A. (Arkansas Univ., Fayetteville (USA). Dept. of Mathematical Sciences). 1988. 12p. NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 5, 885-894(Jun 1988).

This paper presents mechanistic mathematical models that account for two phenomena: (1) interior surfaces of a state-of-the-art emissions test chamber acting as a transient sink for organic emissions; and (2) the effect of increasing chamber concentration on the emission rate of the source. A key point is that the effect of the chamber sink can be adjusted out simply by first fitting the appropriate model, then setting to zero the rate constant which governs sink adsorption/absorption. As a consequence of the mathematical development, a source emission rate as a function of time and a steady-state emission rate factor are given precise definitions.

9219 **(PB—88-251756/XAB) Effects of ozone and water stress on canopy temperature, water use, and water-use efficiency of alfalfa.** Temple, P.J.; Benoit, L.F. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). 1988. 12p. NTIS, PC A03/MF A01.

Pub. in Agronomy Jnl. 80, 439-447(1988).

Ozone ($O_3$) and soil water deficit are two environmental stresses that significantly affect the growth and yield of alfalfa. However, little is known of the responses of field-grown alfalfa to $O_3$, and the effects of the interaction between $O_3$ and water stress on canopy temperature and water relations of alfalfa have not been previously reported. Water use, rate of soil-water depletion, or depth of effective rooting zone were not affected by $O_3$, whereas water stress significantly reduced all three. Water-use efficiency was significantly reduced by $O_3$. The effects of $O_3$ on WUE were attributed to premature senescence and abscission of older alfalfa leaves.

9220 **(PB—88-251848/XAB) Development of sulfur dioxide and ozone exposure profiles that mimic ambient conditions in the rural southeastern United States.** Hogsett, W.E.; Tingey, D.T.; Lefohn, A.S. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). 1987. 13p. (EPA—600/J-87/376). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 3, 659-669(1987).

A design for constructing experimental mixed-pollutant exposure profiles that reflect regional $O_3$ and $SO_2$ ambient air quality is described. The profiles were developed using hourly concentration data from monitoring sites in the southeastern United States where slash pine is indigenous, only using sites designated rural or remote. Each site was characterized by concentration frequency of occurrence and duration of concentration values, length of time between episodes, and frequency of co-occurrence. A base profile, a 30-day hour-by-hour concentation regime, was constructed using averaged air-quality characteristics from the selected sites.

9221 **(PB—88-252929/XAB) Walk-through survey report at Kinston Shirt Company, Kinston, North Carolina, August 30-31, 1982.** Blade, L.M.; Stayner, L.T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Aug 1983. 18p. (IWS—125.23). NTIS, PC A03/MF A01.

A walk-through survey was conducted in August 1982 at the Kinston Shirt Company, Kinston, North Carolina, to evaluate worker exposure to formaldehyde as part of a NIOSH study to locate facilities for inclusion in an industry-wide study of formaldehyde. About 50% of the finished fabric had been treated with formaldehyde-based resin and cured to provide permanent-press characteristics. Personal and area air samples were collected by the sorbent tube method. The direct-reading air-monitoring device malfunctioned and provided no data. Formaldehyde concentration in the air samples ranged from 0.06 to 0.57 parts per million (ppm). Although the formaldehyde concentrations were well below the OSHA standard of 3ppm for an 8-hour time-weighted average (TWA), the authors recommend that dilution ventilation be employed in the facility, especially in the cutting and piece-goods area, to reduce the ambient concentrations of formaldehyde.

9222 **(PB—88-252986/XAB) Walk-through survey report, Westinghouse Air Brake Company, Wilmerding, Pennsylvania, January 25, 1979.** Matanoski, G.; Schott, D. (Johns Hopkins Univ., Baltimore, MD (USA)). Aug 1979. 19p. NTIS, PC A03/MF A01.

A walk-through survey was conducted on January 25, 1979, to determine whether the Westinghouse Air Brake Company of Wilmerding, Pennsylvania, would be suitable for inclusion in an in-depth epidemiological, industrial hygiene, and medical study of health hazards in the painting trades. Methods of paint application and types of paint used were evaluated, along with the areas in which painting operations were conducted. The work force and personnel-records system, medical and industrial hygiene programs, and engineering controls are described. The authors conclude that even though painters had excellent controls for removal of paint and paint vapors, potential exposure of up to 18 employees was observed. The company had an excellent record system, which allowed identification of employees over several years. NIOSH recommended that this site be considered for an in-depth study of potential hazards of the painting industry.

9223 **(PB—88-252994/XAB) NIOSH Current Intelligence Bulletin 50 - carcinogenic effects of exposure to diesel exhaust, August 1988.** Brown-McCammon, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1988. 41p. (DHHS/PUB/NIOSH—88-116). NTIS, PC A03/MF A01.

See also PB—83-105080.

The bulletin presents recent information on the potential carcinogenicity of diesel exhaust. Included are discussions of recent animal studies that confirm the relationship between cancer and exposure to whole diesel exhaust. Also discussed is epidemiological evidence that associates lung cancer with occupational exposure to diesel engine emissions. On the basis of the results of these studies, NIOSH recommends that whole-diesel exhaust be regarded as a potential occupational carcinogen in conformance with the Occupational Safety and Health Administration (OSHA) cancer policy (29 CFR 1900).

9224 **(PB—88-869912/XAB) Particle collection: methods and applications. June 1970-September 1988 (Citations from the COMPENDEX data base). Report for June 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 121p. NTIS PC N01/MF N01.

Supersedes PB—86-875739.

This bibliography contains citations concerning investigations and applications of air-pollution collectors and samplers for airborne particulates. Collection mechanisms and particle characterizations are discussed. Citations regarding electrostatic precipitators are found in a separate bibliography. (This updated bibliography contains 248 citations, 80 of which are new entries to the previous edition.)

9225 **(PB—89-100226/XAB) Effectiveness of Local-Exhaust Ventilation for drum-filling operations. Final report.** Kumar, V. (PEI Associates, Inc., Cincinnati, OH (USA)). 13 May 1988. 134p. NTIS, PC A07/MF A01.

The effectiveness of Local Exhaust Ventilation (LEV) in capturing vapors generated was evaluated using a drum-filling operation as an example. The experiment consisted of measuring the effectiveness of three LEV systems (a canopy hood, a slot hood, and a lay-on hood). It was found that when operated at the ACGIH design flow rates, the hoods were highly effective in capturing emissions from drum-filling operation. Capture efficiencies for canopy hoods ranged from 93 to 100% based on total emission from the drum; for the slot hood and the lay-on hood capture efficiencies were determined to be 95 to 100% and 100%, respectively. In general, it was found the efficiency of an LEV system for a drum-filling operation is independent of the concentration of emission leaving the drum. The drum-fill rate, which determines emission velocity at the drum bung hole, was shown to affect LEV efficiency for the slot hood used in the study.

9226 **(PB—89-100366/XAB) Hazard Evaluation Division Standard Evaluation Procedure, Inhalation Toxicity Testing.** Gross, S.B.; Vocci, F.J. (Environmental Protection Agency, Washington, DC (USA). Office of Pesticide Programs). 1 Aug 1988. 48p. (EPA—540/09-88/101). NTIS, PC A03/MF A01.

The Standard Evaluation Procedure (SEP) for Inhalation Toxicity Testing discusses the requirements for inhalation toxicity testing defined in the Agency Guidelines. It discusses the different types of inhalation experiments that are usually carried out, the species usually used, exposure and generating systems, and the analyses of the exposure atmospheres. The SEP explains the reasons for the different requirements and how the requirements are usually met. There is some discussion on dealing with various problems that arise in these tests and a brief discussion on the basis for rejecting an inhalation study.

9227 **(PB—89-100762/XAB) Industrial-hygiene study of the Gouverneur Talc Company, Number One Mine and Mill, Balmat, New York, November 3-7, 1975. Volume 1. Final report.** Dement, J.M.; Zumwalde, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). 8 Jun 1977. 160p. (IWS—036-12-1). NTIS, PC A08/MF A01.

See also PB—81-224719. Portions of this document are not fully legible.

Bulk samples of talc were collected and personal air sampling was conducted in the mine and the mill. X-ray diffraction and optical or electron microscope analysis was conducted by NIOSH and two independent laboratories. All laboratories confirmed the presence of asbestiform tremolite and anthophyllite in the bulk talc samples at concentrations of 67 to 88 and 4 to 12%, respectively. Time-weighted average (TWA) values for fiber and dust personal exposures for almost 30 job categories ranged from 1.7 to 9.8 fibers greater than 5 microns per cubic centimeter, and 0.25 to 2.96 milligrams per cubic meter, respectively. Free silica exposures were very low. Analysis of the impinger samples revealed excessive exposure to asbestos at almost every mine and mill operation. The authors conclude that excessive exposures to airborne fibers exist in both mine and mill. Recommendations include improved ventilation, upgraded equipment maintenance, and provision of respiratory protection to employees.

9228 **(PB—89-100903/XAB) Plan for study: response of the habitat and biota of the inner New York Bight to abatement of sewage sludge dumping. Technical memo.** (National Marine Fisheries Service, Woods Hole, MA (USA). Northeast Fisheries Center). Jun 1988. 41p. (NOAA-TM-NMFS-F/NEC—55). NTIS, PC A03/MF A01.

The purpose of this study was to document changes in living marine resources and their habitats during and following the period in which sewage sludge dumping is phased out at the 12-mile site. Choice of monitoring variables was based on two considerations: (1) relevance to fisheries of the inner Bight, both directly, in terms of abundance, distribution, and contamination of resource species and indirectly, as indicated by quality of their habitats, and (2) predictive value in detecting changes with abatement. Biological, chemical, and physical oceanographic approaches were integrated to provide comprehensive and statistically valid work plans.

9229 **(PB—89-100960/XAB) Industrial-hygiene study of the Engelhard Minerals and Chemicals Corporation, Attapulgus, Georgia, March 22-26, 1976.** Zumwalde, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1977. 82p. (IWS—52.16). NTIS, PC A05/MF A01.

Worker exposures to dust and free silica were surveyed at Engelhard Minerals and Chemicals Corporation in Attapulgus, Georgia, March 22-26, 1976. The company employed about 395 workers and provided medical and industrial hygiene services through local consultants. Dust concentrations sometimes exceeded OSHA standards of 5 and 15 milligrams per cubic meter for respirable and total dust, respectively. Free silica concentrations were within acceptable limits; the OSHA standard was not provided. Various amounts of attapulgite clay were found in the dust samples. Noise levels ranged from 73 to 105 decibels relative to the A-weighted scale. The author recommends improved ventilation and housekeeping procedures, use of hearing protection devices, and reduction of radiant heat release near the dryers.

9230 **(PB—89-101083/XAB) Walk-through survey report, Aluminum Company of America (ALCOA), Wenatchee, Washington, July 26, 1978.** Brown, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1978. 5p. (IWS—038.22). NTIS, PC A02/MF A01.

Worker exposures to particulate polycyclic organic matter (PPOM) were surveyed at the Aluminum Company of America (ALCOA), in Wenatchee, Washington on July 26, 1978. The company was under consideration for inclusion in a retrospective NIOSH study of the health effects of occupational PPOM exposure. The company maintained one part-time physician and four emergency medical technicians. The author concludes that the facility is suitable for inclusion in the PPOM hazards survey because it is representative of prebake facilities and is the oldest operating facility examined. The author recommends that the facility be used for further study.

9231 **(PB—89-101133/XAB) Industrial-hygiene survey of the Stauffer Chemical Company, Lemoyne Plant, Axis, Alabama, January 9-12, 1978.** Zaebst, D.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1978. 46p. (IWS—75-12). NTIS, PC A03/MF A01.

Worker exposures to carbon disulfide and carbon tetrachloride were determined at the Stauffer Chemical Company, Lemoyne Facility, Axis, Alabama, on January 9-12, 1978. Approximately 50 of the workers at the facility were assigned to the carbon disulfide and carbon tetrachloride production areas surveyed. The company maintained a safety and industrial hygiene program. With one exception, time-weighted average (TWA) exposures of first- and second-class operators of the carbon disulfide and carbon tetrachloride units to carbon-disulfide were relatively low, ranging from none detected to 0.99 parts per million (ppm). Carbon disulfide TWA exposures for loading workers ranged from 5.5 to 31.2ppm, compared with the OSHA standards of 20ppm for continuous eight-hour exposures. TWA average exposures of first and second class operators to carbon tetrachloride averaged 0.43ppm and 1.8ppm, respectively, although individual eight-hour exposures ranged from 7.5ppm to 9.5ppm. Loading-workers' TWA exposures to carbon tetrachloride ranged from 10.4 to 16.6ppm. The author recommends modification of loading workers sampling procedures, and the use of appropriate respiratory protective equipment by the loading workers.

9232 **(PB—89-101141/XAB) Industry-wide studies report of an industrial-hygiene survey at the Cutler US Army Community Hospital, Fort Devens, Massachusetts, January 7-10, 1985.** Elliott, L.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1985. 33p. (IWS—152.12). NTIS, PC A03/MF A01.

An industrial-hygiene survey of exposures to ethylene oxide at Cutler United States Army Community Hospital, Fort Devens, Massachusetts, was conducted in January 1985. Breathing-zone and general-area sampling for ethylene oxide in the Central Materials Supply (CMS) area was performed. The only personal protective equipment used by personnel in the CMS area was polyvinyl gloves to transfer sterilized items from the sterilizer to the aerator. Respiratory protective equipment was not used or provided. Breathing-zone ethylene oxide exposures ranged from below the detection limit to 0.83 part per million (ppm). Short-term exposures of 2.40 and 17.84ppm occurred. The OSHA 8-hour time-weighted average (TWA) standard for ethylene oxide is 1.0ppm. Area ethylene oxide concentrations ranged up to 58.3ppm. The author concludes that except for the short term 17.84ppm exposure, which equals 1.1ppm on a TWA basis, breathing-zone ethylene oxide concentrations did not exceed the OSHA standard. Exposure potential in the hospital could be reduced further by improving work practices and installing engineering controls.

9233 **(PB—89-101174/XAB) Walk-through survey report of Vapor Products, Incorporated, Orlando, Florida, May 17, 1982.** Elliott, L.; Blade, L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1983. 27p. (IWS—125.20). NTIS, PC A03/MF A01.

A walk-through survey was conducted on May, 17, 1982, at Vapor Products, Inc., Orlando, Florida, to determine the extent of worker exposure to formaldehyde and to evaluate an experimental procedure for quantification of formic acid in urine. Personal and area air samples were collected and analyzed for formaldehyde. Urine samples were collected from several employees before and after shift work, and formic-acid concentrations were determined. The time weighted average (TWA) exposure concentrations in breathing-zone air samples ranged from less than 0.25 to 1.91 parts per million (ppm) formaldehyde. The formaldehyde concentration in area air samples ranged from 0.28 to 3.40ppm. The procedure used to quantify formic acid in urine had excessively wide variation between replicate analyses, and the results were not reported because they were considered invalid. Personal airborne exposures were well below current OSHA standards of 3ppm for an 8-hour TWA, 5ppm for a ceiling value, and 10ppm for a peak excursion, but some were above the 1ppm concentration formerly recommended by NIOSH to protect workers from the irritant effects of formaldehyde. The authors recommend changes in the ventilation system and modification of work practices in the rework and clean-up area to avoid paraformaldehyde dust exposure.

9234 **(PB—89-101257/XAB) Monochlorobenzene survey report, Monsanto Corporation, W.G. Krumrich Plant, Sauget, Illinois. April 6-7, 1977.** Diamond, P. (SRI International, Menlo Park, CA (USA)). Jun 1977. 40p. NTIS, PC A03/MF A01.

See also PB—83-134627.

Monsanto Corp., a factory where monochlorobenzene (MCB) was produced; was surveyed. The factory employed 1300 persons, including 14 workers involved in MCB production. The factory produced over 100,000,000 pounds of MCB in a year. The MCB process equipment was outdoors, and no ventilation system was noted. Equipment consisted of a 10-year-old closed system. During most of the operation, the workers remained indoors in a control-room block house located in the middle of the MCB production facility. A portable, total organic vapor analyzer was used to sample vapor concentrations on the walk-through survey. Less than 3 parts per million (ppm) total hydrocarbons, calibrated as MCB were detected. Charcoal tube air samples were also collected for 4.5 hours in the MCB area. They were in the 1 to 2ppm range for benzene and MCB. The author concludes that there is insignificant exposure to MCB, but that the facility requires further investigation. The author recommends additional monitoring to determine combined solvent exposure and exposure to nitrochlorobenzene, one of the products derived from MCB.

9235 **(PB—89-101265/XAB) Industry-wide studies report of an in-depth industrial-hygiene survey of the Dow Chemical, Michigan Division, Midland, Michigan, September 11-13, 1984.** Greife, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1985. 31p. (IWS—145.12A). NTIS, PC A03/MF A01.

See also PB—85-207843.

An indepth survey was conducted at Dow Chemical Company. The purpose of the survey was to investigate the acrylamide and polyacrylamide production facilities as part of an industry-wide assessment of acrylamide exposures. Three production facilities were involved in the production of acrylamide monomer or polymer. Breathing-zone, general-area, and wipe samples were collected in all three facilities for a single day shift and analyzed for acrylamide. The highest airborne acrylamide concentrations (breathing zone, 0.119 cu m and general area, 0.054mg/cu m, were found in the monomer facility. Most of the general air samples were below the limit of detection, 0.002mg/cu m. All but two of the wipe samples were below the limit of detection, 0.5 microgram (microg) per sample. The author concludes that all samples collected during the survey were below any standard or recommended evaluation criteria for acrylamide. Evaluating work practices to reduce potential dermal exposure is recommended.

9236 **(PB—89-102990/XAB) Clean technology: doing what you shouldn't forget to do.** (Technische Univ. Twente, Enschede (Netherlands)). 3 Dec 1987. 74p. (In Dutch). NTIS, PC E04/MF A01.

This report presents the proceedings of a 1987 symposium, entirely in Dutch, concerning clean-air technology status and needs for Europe. Attention is given to control technologies currently in hand, research needs, control measures needed for various air pollutants (including oxides of nitrogen and sulfur), pollution prevention, environmental quality, and policy considerations.

9237 **(PB—89-103162/XAB) Application of GC/ITD (gas chromatography/ion trap detector) to environmental analysis (journal version).** Mitchum, R.K.; Pyle, S.M. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). 1988. 7p. (EPA—600/J-88/059). NTIS, PC A02/MF A01.

Pub. in Speactra, Vol. 11, No. 2, 21-25(1988).

The choice of gas chromatography (GC) detectors has expanded rapidly. The necessity for mass spectrometric (MS) characterization of GC effluents stems from the complexity of the matrices associated with environmental samples. There are currently several MS types being used in conjunction with GC. These include magnetic sector analyzers, quadrupole ion trap and ion cyclotron resonance (ICR) mass spectrometers. This paper is concerned with the application of the ion trap MS detector (ITD) to environmental analysis. The GC/ITD has provided representative mass spectra for

the analysis of purge-and-trap volatiles and hazardous-waste steam distillate. The ability to obtain library matchable EI spectra on a routine basis indicated that the ITD technique can successfully analyze environmental samples.

9238 **(PB—89-103428/XAB) National Air Toxics Information Clearinghouse: ongoing research and regulatory development projects, July 1988. Interim report.** Buchanan, S.K.M.; Moody, T.K. (Radian Corp., Research Triangle Park, NC (USA). Progress Center). Jul 1988. 194p. (DCN—88-239-001-44-07). NTIS, PC A09/MF A01.

See also PB—88-113196.

The document is divided into two parts and an appendix. The first part lists 365 air toxics projects currently in progress at EPA, NIOSH, and State and local agencies. A brief description of each project and a contact name, office, and telephone number are given. The second part of the document contains the index that allows readers to locate projects of interest. Projects are indexed by agency, project type, chemical name, Chemical Abstract Service (CAS) number, and source category Standard Industrial Classification (SIC) Code. The appendix lists regulatory development projects on toxic chemicals underway at the EPA's Office of Drinking Water (ODW). While most of these projects are not directly related to air problems, health information on toxic chemicals from ODW projects may be of interest to Clearinghouse users.

9239 **(PB—89-103436/XAB) National Air Toxics Information Clearinghouse: bibliography of selected reports and Federal Register notices related to air toxics. Volume 2. Citations, 1988. Interim report.** Mangum, J.H.; Norris, C.E.; Owen, C.A. (Radian Corp., Research Triangle Park, NC (USA). Progress Center). Jul 1988. 191p. (DCN—88-239-001-44-08). NTIS, PC A09/MF A01.

See also PB—89-103444 and Volume 1, PB—88-136601.

The bibliography is published in two volumes plus an index. Volume 1 contains cumulative citations from before 1974 through March 1987. Volume 2 has the more recent citations from April 1987 through March 1988 (taken from sources available through March 31, 1988). The volume consists of two parts. Part 1 includes introductory material describing the scope and organization and contains information necessary for the proper use of the document. Volume 2, Part 2 contains the report and Federal Register notice entries with bibliographic information and, in most cases, an abstract. The index to the bibliography covers all the reports from 1974 to the present. Each listing indicates which of the two volumes contains the citation. The current index is organized by document type; by pollutant class, name, or Chemical Abstracts Service (CAS) number; by source category Standard Industrial Classification (SIC) Code; and by sponsoring agency.

9240 **(PB—89-103444/XAB) National Air Toxics Information clearinghouse: bibliography of selected reports and federal register notices related to air toxics Index 1988. Interim report.** Mangum, J.H.; Norris, C.E.; Owen, C.A. (Radian Corp., Research Triangle Park, NC (USA). Progress Center). Jul 1988. 449p. (DCN—88-239-001-44-09). NTIS, PC A19/MF A01.

See also Volume 2, PB—89-103436 and Volume 1, PB—88-136601.

The bibliography is published in two volumes plus an index. Volume 1 contains cumulative citations from before 1974 through March 1987. Volume 2 has the more recent citations from April 1987 through March 1988 (taken from sources available through March 31, 1988). The volume consists of two parts. Part 1 includes introductory material describing the scope and organization and contains information necessary for the proper use of the document. Volume 2, Part 2 contains the report and Federal Register notice entries with bibliographic information and, in most cases, an abstract. The index to the bibliography covers all the reports from 1974 to the present. Each listing indicates which of the two volumes contains the citation. The current index is organized by document type; by pollutant class, name, or Chemical Abstracts Service (CAS) number; by source category Standard Industrial Classification (SIC) Code; and by sponsoring agency.

9241 **(PB—89-103592/XAB) Thermal destruction of hazardous waste: a state-of-the-art review.** Freeman, H.M.; Olexsey, R.A.; Oberacker, D.A.; Mournighan, R.E. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). 1987. 18p. (EPA—600/J-87/440). NTIS, PC A03/MF A01.

Pub. in Jnl. of Hazardous Materials, 14, 103-117(1987). See also PB—86-145505.

The authors provide an overview of thermal treatment, a discussion of EPA incineration regulations, and discussion of several specific thermal processes. Included are discussions of rotary kilns, liquid injection systems, industrial boilers, industrial processes using waste as fuel ocean incineration, and new thermal processes. The discussion addresses how the systems work, what the capabilities of the system are, and to what extent they are being utilized. The paper is of interest to those interested in a broad overview of incineration today.

9242 **(PB—89-103659/XAB) Review of the Office of Air-Quality Planning and Standard's lead benefit valuation methodology. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 30 Jun 1987. 15p. (SAB/CASAC—87/032). NTIS, PC A03/MF A01.

The program's lack of clearly stated scientific assumptions and objectives, and its need for a more-consistent approach to peer review, constitute its most-serious technical deficiencies. The absence of consistently documented assumptions and objectives, and assessing whether the program as a whole, or specific studies, have achieved their overall goals and also were noted as deficiencies.

9243 **(PB—89-103949/XAB) Evaluation retest on a hospital-refuse incinerator at Sutter General Hospital, Sacramento, California.** Jenkins, A.; Ouchida, P.; Lew, G. (California State Air Resources Board, Sacramento (USA). Monitoring and Lab. Div.). Apr 1988. 125p. (ARB/ML—88-026). NTIS, PC A06/MF A01.

An evaluation test program was conducted to evaluate the effect of incinerator design changes on emissions from the hospital-refuse incinerator. The test was conducted as a part of the California Air Resources Board's program to assess emissions from stationary sources. Daily average oxygen concentrations ranged from 12.1-15.6% and the daily average carbon dioxide concentrations ranged from 4.0-5.5%. Dioxin emissions ranged from 21.0 nanograms per second (ng/sec) for tetrachlorodioxin to 355 ng/sec for the heptachlorodioxin. Furan emission rates ranged from 253 ng/sec for the tetrachlorofuran to 477 ng/sec for the heptachlorofuran. The mass emission rates of hydrochloric acid ranged from 2.6 to 5.8 pounds per hour.

9244 **(PB—89-103964/XAB) Comparison of historic $SO_2$ and NOx emission data sets. Final report, January 1987-March 1988.** Gschwandtner, G.; Wagner, J.K.; Husar, R.B. (Pechan (E.H.) and Associates, Inc., Durham, NC (USA)). May 1988. 169p. (EPA—600/7-88/009A). NTIS, PC A08/MF A01.

For system on diskette, see PB—89-103956.

This report gives results of a comparison of historic $SO_2$ and NOx emission data sets. During the past few years, several research projects were conducted to reconstruct historic air-pollution emission trends in the U.S. The report compares in detail the emission estimates and attempts to determine the methodological differences that result in different emission estimates. In addition, the U.S. EPA historical trends, the electric-utilities emissions estimates and the NAPAP monthly trends inventory are compared to Gschwandtner's inventory. One objective of the study was to determine a basis for changing any of the existing estimates in order to minimize or eliminate unnecessary differences in reported national total emissions for common years. Revised NOx and $SO_2$ emission estimates, based primarily on Gschwandtner and EPA trends, are recommended for use in future analyses utilizing historic emission estimates.

9245 **(PB—89-104277/XAB) National Air Toxics Information Clearinghouse: case studies in risk communication. Final report.** (Radian Corp., Research Triangle Park, NC (USA). Progress Center). Jun 1988. 48p. (DCN—88-239-001-38-11). NTIS, PC A03/MF A01.

The report documents the risk-communication experience of three agencies. Case studies are presented describing the experience of the Puget Sound (Washington) Air Pollution Control Agency and the San Diego County (California) Air Pollution Control District in communicating the results of source-specific cancer risk assessments. Routine risk-communication practices, rather than a specific case study, are presented for Maryland's Department of the Environment. The report is intended to be most useful to State and Local agencies just beginning to do quantitative cancer-risk assessments, and seeking to benefit from the risk communication experience of others.

9246 **(PB—89-106306/XAB) Engineering evaluation and control of toxic airborne effluents. Volume 1. Single droplet studies of surrogate hazardous-waste incineration. Volume 2. Research and development of methods for the engineering evaluation and control of toxic airborne effluents. Report for 1986-1988.** Sorbo, N.W.; Chang, D.P.Y.; Steeper, R.R.; Bell, R.L.; Morrison, B.J. (California Univ., Davis (USA)). May 1988. 228p. NTIS, PC A11/MF A01.

The report is issued in two volumes. Volume 1 is entitled Single-Droplet Studies of Surrogate Hazardous-Waste Incineration; Volume 2 is entitled Research and Development of Methods for the Engineering Evaluation and Control of Toxic Airborne Effluents, and consists of two parts: (1) Transport of Volatile Organic Compounds; and (2) Volatile Organic Compound Emissions from Soils. Vol. 1 describes research to characterize the burning and vaporization of single droplets of various chlorinated hydrocarbons, to develop a single droplet incinerability ranking methodology which could complement existing incinerability ranking methodologies. Thus ranked, the chlorinated hydrocarbons could be used in the treatment and disposal of hazardous wastes through hazardous-waste incineration. Part 1 of Volume 2 attempts to quantify emissions of volatile organic compounds from oil sumps; Part 2 describes the volatilization of fuel components from leaking underground gasoline-storage tanks.

9247 **(PB—89-107254/XAB) Hazard-evaluation and technical-assistance report HETA 88-154-0000, Centre County State Health Center, State College, Pennsylvania.** Roper, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Jun 1988. 22p. (HETA—88-154-0000). NTIS, PC A03/MF A01.

In response to a request from the Pennsylvania Department of Health, an evaluation was made of worker health complaints including burning of the eyes, throat, and nose, among the staff at the Centre County State Health Center, State College, Pennsylvania. The building was 1 year old, and had only three or four windows (none of which opened). A survey indicated elevated levels of carbon-dioxide were present, there were deficiencies in the heating, ventilation and air conditioning (HVAC) system, humidity was low and the humidifier was inoperative, and the outside air intake valve was downwind of service station air-pollutant emission sources. No carbon monoxide, nitrogen dioxide, formaldehyde, or gasoline was detected in the air. Toluene and hydrocarbons were detected, but not at unusual levels. Siloxane compounds were detected in the building air. Volatile organic compounds ranged from 101 to 231 micrograms/cubic meter. A questionnaire concerning indoor air quality was administered to workers. Case histories of three workers previously diagnosed with pneumonia were reviewed. The author makes recommendations that address each of the difficulties in the ventilation system.

9248 **(PB—89-107262/XAB) Health-hazard evaluation report HETA 88-031-1894, Camp Bird Ventures, Ouray, Colorado.** Daniels, W.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 21p. (HETA—88-031-1894). NTIS, PC A03/MF A01.

In response to a request from Camp Bird Ventures, Ouray, Colorado, an evaluation was made of possible hazardous working conditions with particular attention given to lead exposures. Camp Bird Ventures was engaged in underground mining for gold and silver; fire assays were performed on ore samples. Two employees had been found to have excessive blood lead levels. Personal protective equipment worn by employees engaged in fire-assay work in the furnace and storage rooms included disposable full body suits, boot covers, and half face respirators. Time-weighted average (8 hour) lead concentrations in personal air samples were 113 and 40 micrograms per cubic meter (microg/$m^3$) for the assayer and scale operator, respectively. The OSHA permissible exposure limit for lead was 50 microgrg /$m^3$ as an 8 hour time weighted average. Area air concentrations of lead were 100 microg/$m^3$ in the furnace room, 58 microgm/$m^3$ in the storage room, and 46 microg/$m^3$ in the office. The author concludes that a potential health hazard existed from employee exposure to lead in the fire-assay operations.

9249 **(PB—89-107395/XAB) Preliminary survey report: evaluation of brake-drum-service controls at US Army Armor Center, Fort Knox, Kentucky.** Godbey, F.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1988. 9p. (CT—152-15A). NTIS, PC A02/MF A01.

A visit was made to the U.S. Army Armor Center, Fort Knox, Kentucky, as part of a study of asbestos hazards encountered during the maintenance and repair of vehicular brakes. Approximately 800 vehicles were maintained at the center each year with about 100 brake jobs being needed during that course of time. Exposure to asbestos may occur during cleaning, maintenance, and repair of brakes. Workers were encouraged to use good work practices including the complete water rinsing and wet-bristle brushing of all exposed parts prior to handling, gently removing and handling all parts, consistently using all required personal protective equipment, and following instructions for use of asbestos-control devices. Annual physical examinations were provided for workers performing vehicular brake-repair services. The author concludes that the facility did not appear to have asbestos controls sufficient to protect the workers from asbestos dust arising from service operations. The advisability of conducting an in depth evaluation of the controls at the facility will be made in the future, after all the preliminary surveys and finalization of the protocol for the project has been reached.

9250 **(PB—89-107445/XAB) Health hazard evaluation report HETA 82-354-1897, Kemper-Tappan, Richmond, Indiana.** Wallingford, K.M.; Elliot, L.J.; McAuley, D.B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 32p. (HETA—82-354-1897). NTIS, PC A03/MF A01.

In response to a request from an authorized representative of employees at Kemper-Tappan, Richmond, Indiana, an evaluation was made of possible health hazards existing at the site, with particular reference to formaldehyde and solvent exposures. At the facility wood- and wood-product cabinets were manufactured for household use. The primary source of formaldehyde was particle board used in the cabinets. Most of the 8-hour time-weighted average exposure levels for formaldehyde were above the NIOSH recommended exposure limit. Exposures to organic hydrocarbons resulted from the use of solvents, spray finishes, glues, and adhesives, but levels were below the applicable exposure criteria. Total dust exposures ranged from nondetectable to 2.8 microgram/$m^3$ for the bandsaw operator. The authors conclude that a potential health hazard existed from airborne exposures to formaldehyde and to hardwood dust, and make recommendations.

9251 **(PB—89-107775/XAB) Health-hazard evaluation report No. HETA-87-181-0000, Graphic Packaging Corporation, Paoli, Pennsylvania.** Crandall, M.S.; Wilcox, T.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Jul 1988. 13p. (HETA—87-181-0000). NTIS, PC A03/MF A01.

An evaluation was made of working conditions at the Graphic Packaging Corporation, Paoli, Pennsylvania. Particular attention was given to workers making microwave popcorn bags

who reported swelling around the eyes and dermatitis. One employee also reported an asthma attack while working on the bags. Special water-based epoxy adhesives were used for these bags as the product must withstand heating in a microwave oven. Environmental and personal breathing-zone air samples were taken and medical questionnaires were filled out. Use of the adhesive was discontinued in May of 1987 and the symptoms have disappeared. Chemical analysis of the adhesive indicated the presence of several chemicals that are potential irritants or allergic sensitizers both to skin and the respiratory tract. These irritants included formaldehyde, acetaldehyde, benzoic acid, 1,1,1-trichloroethane, p-dioxane, and ethyl acetate. Samples taken before the switchover to another adhesive was made did not indicate a hazardous level of any of these substances to be present.

9252 **(PB—89-107809/XAB) Health-hazard evaluation report no. HETA-87-404-1893, Park County Courthouse, Fairplay, Colorado.** Lee, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 15p. (HETA—87-404-1893). NTIS, PC A03/MF A01.

In response to a request from employees at the Park County Courthouse, Fairplay, Colorado, an evaluation was made of indoor air quality at the facility, with specific reference to symptoms of headaches, ringing in the ears, worsening eyesight, and sinus problems. Six people worked at the building which had been constructed 2 years earlier. Air samples were taken at the facility and analyzed for formaldehyde by visible spectroscopy. Formaldehyde levels were measured at 0.03 to 0.06 parts per million (ppm), with a mean of 0.05ppm in the offices and courtrooms. As a result of recommendations, the building was made a no smoking area, and outside air vents were connected to the furnaces. At a followup visit, carbon dioxide levels were about 250ppm throughout the building, reaching a maximum of 400ppm at 9:30 in the morning, when 29 people were present in the building. Relative humidity ranged from 14 to 18%. The author concludes that there was no hazard due to exposure to formaldehyde, and that adequate amounts of fresh air were supplied throughout the building. The author recommends increasing the relative humidity to about 40% to alleviate upper respiratory irritation caused by dry air during the heating season.

9253 **(PB—89-107817/XAB) Health hazard evaluation report No. HETA-87-384-1895, Polymer Engineering, Inc., Reynolds, Indiana.** Fleeger, A.K.; Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 17p. (HETA—87-384-1895). NTIS, PC A03/MF A01.

An evaluation was made of possible hazardous working conditions during the manufacture of thermoset microwave cookware and custom-molded plastic parts. Particular attention was given to exposure to styrene in the Compounding Department. In the department the primary constituents of the plastics were weighed, mixed, blended, extruded, and placed in crates for transport to the Pressing Department. The highest personal time-weighted average exposures were analyzed and indicated a mean exposure level of 44.6 parts per million (ppm). There were exposure levels for each of the three extruder operators which exceeded the 50.0ppm NIOSH Recommended Exposure Limit. Short term personal exposures in the Compounding Department ranged from 26.6 to 39.1ppm. Total dust exposures ranged from 1.0 to 12.3mg/$m^3$ throughout the facility. Personal samples in the Compounding Department showed exposures at 12.3mg/$m^3$. The authors conclude that a health hazard existed from styrene and nuisance-dust exposures. They recommend changes in the ventilation system, installation of local exhaust ventilation at the extruder operations, and enclosure of the preweigh station.

9254 **(PB—89-107825/XAB) Health-hazard evaluation report HETA-87-268-1900, Bestop, Inc., Longmont, Colorado.** Nichting, A.T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). May 1988. 17p. (HETA—87-268-1900). NTIS, PC A03/MF A01.

See also PB—88-153325.

In response to a request from the management of Bestop, Inc., Longmont, Colorado, an evaluation was made of possible hazardous conditions at the facility due to exposure to urethane polyester powder coating, painted on automotive metal accessory parts using an electrostatic spray-application method. Full shift personal breathing zone and area air samples indicated the range for nuisance dust to be 1.42 to 12.21mg/cu m and 0.09 to 1.27mg/cu m, respectively. Airborne concentrations of caprolactam dust, caprolactam vapor, and isocyanates were all below existing criteria. The complaints and symptoms of the workers included eye irritation, skin irritation, and respiratory-system difficulties, related to the excessive amounts of nuisance dust. The author concludes that at the time of the survey, there was a health hazard from exposure to nuisance dust. The author recommends specific measures be taken to reduce worker exposures to nuisance dust. Recommendations concern respiratory use, use of cooling air, possible heat stress, personal protective clothing, personal hygiene, equipment inspection, and medical surveillance.

9255 **(PB—89-107882/XAB) Nonmethane organic-compound and air-toxics monitoring program. Final report 1987. Volume 1. Hydrocarbons.** (Radian Corp., Research Triangle Park, NC (USA)). Aug 1988. 363p. NTIS, PC A16/MF A01.

See also Volume 2, PB—89-107890, and PB—86-120631.

Samples of ambient air were collected at 32 sites in the U.S. during June through September 1987 on week days from 0600 to 0900 hours. Analysis for the NMOC concentration was by PDFID. Data were used in the EKMA ozone model. An extensive QA program carried out with the samples shows good precision and accuracy of the method. Data from all the samples are tabulated together with an extensive discussion of the QA program.

9256 **(PB—89-107890/XAB) Nonmethane organic compound and air-toxics monitoring program. Final report 1987. Volume 2. Toxic species.** (Radian Corp., Research Triangle Park, NC (USA)). Aug 1988. 75p. NTIS, PC A04/MF A01.

See also Volume 1, PB—89-107882.

Samples of air were collected at 15 sites in the U.S. during June through September, 1987 on weekdays from 0600-0900 hours. Some of the samples were analyzed for 28 putative toxic compounds by a gas-chromatographic, multi-detector procedure. Verification of compound identified was by mass spectrometer. Data from all the samples (about 10 per site) are reported. A description of the apparatus used is given together with results from the QA program also carried out.

9257 **(PB—89-108237/XAB) BACT/LAER (best available control technology/least allowable emission rate) information system (BLIS) user's manual, June 1988.** Steigerwald, J.; Paul, R. (PEI Associates, Inc., Durham, NC (USA)). Jun 1988. 80p. NTIS, PC A05/MF A01.

See also report dated Aug 1983, PB—84-142249.

In this report, Section 1 is the introduction. Section 2 describes the data stored in BLIS and the organization of these data. Section 3 instructs the user in how to gain access to BLIS. Section 4 lists the procedures for obtaining printed reports, and Section 5 instructs the user on data submission.

9258 **(PB—89-110639/XAB) Wood-smoke-impacted air: mutagenicity and chemical analysis of ambient air in a residential Area of Juneau, Alaska (journal version).** Watts, R.R.; Drago, R.J.; Merrill, R.G.; Williams, R.W.; Perry, E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1988. 11p. (EPA—600/J-88/136). NTIS, PC A03/MF A01.

Pub. in Jnl. of the Air Pollution Control Association. See also PB—88-160593.

The study was undertaken to determine the bacterial mutagenicity (Ames test) and chemical characteristics of respirable particulate matter collected in the area. Fine particle concentrations for the sampling period of November 16th to January 7th ranged from 1.19 to 209.8 microgram/cu m. Bioassay samples from ambient-air fine-particle concentration periods of 25.6 to 209.8 microgram/cu m showed indirect acting mutagenicities of 6.64 to 77.8 rev./cu m with a mutagenicity/particle concentration correlation coefficient of 0.89. The indirect acting mutagenic potency values ranged from 0.29 to 1.44 rev./microgram of extracted organics and

averaged 0.73 +/- 0.26. Correlations between fine particle concentration, indirect acting mutagenicity and PAH concentrations were observed for most periods throughout the study. A comparison of ambient air samples collected from wood smoke impacted residential areas in Raleigh, NC, Albuquerque, NM and Juneau showed that the relationship between ambient air mutagenicity and fine particle concentration was similar for each location.

9259 **(PB—89-850218/XAB) Cigarette pollution effects on humans. November 1986-October 1988 (Citations from Pollution abstracts). Report for November 1986-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 60p. NTIS PC N01/MF N01.

Supersedes PB—87-868840.

This bibliography contains citations concerning health consequences to human beings of primary and secondary exposure to cigarette smoke and its various gaseous and particulate components by themselves, and in conjunction with other pollutants encountered in the natural environment and in special types of environments. Technical and economic aspects of cigarette pollution are considered. (This updated bibliography contains 127 citations, 39 of which are new entries to the previous edition.)

9260 **(PB—89-851026/XAB) Odor pollution. January 1977-November 1988 (Citations from the NTIS data base). Report for January 1977-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 103p. NTIS PC N01/MF N01.

Supersedes PB—88-853924.

This bibliography contains citations concerning odorous air pollutants, and odors and tastes in water. Sources include agricultural and livestock wastes, sewage sludge, industrial wastes, vehicular exhausts, hospitals, and polluted water streams. Treatment methods, environmental protection aspects, and human factors are discussed. (This updated bibliography contains 162 citations, 14 of which are new entries to the previous edition.)

9261 **(PB—89-851513/XAB) Cigarette smoking in the business environment. January 1970-November 1988 (Citations from the Management Contents data base). Report for January 1970-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 28p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the impact of cigarette smoking in the workplace. Costs and benefits of corporate smoking policies are considered. Health promotions and an employee's right to smoke are discussed. Space considerations, designated smoking areas, and corporate smoking policy implementation are examined. Corporate programs that encourage employees to quit smoking as part of employee fitness plans are considered. (Contains 50 citations fully indexed and including a title list.)

9262 **(PB—89109656/XAB) Analysis of cyclopentafused isomers of benz(a)anthracene in wood smoke (journal version).** Kamens, R.M.; Fulcher, J.N.; Ball, L.M.; Gold, A. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Biomedical and Environmental Mass Spectrometry, Vol. 14, 369-374(1987).

A previously-unidentified peak occurring in chromatograms of the polycyclic aromatic hydrocarbon fraction from wood-smoke particulate extracts analyzed by capillary gas chromatography on a DB-5 column was found to correspond in retention index and molecular mass either to benzo(a)fluoranthene or to benzo(l)aceanthrylene, one of a series of four novel and highly mutagenic cyclopentafused isomers of benz(a)anthracene. Detailed subfractionation, and re-analysis on a liquid crystal capillary column, indicated that the identity of this peak was most likely to be benzo(a)fluoranthene, a compound not previously reported in wood smoke.

9263 **(UBA-FB—86-092(pt.A)) Determination of dry and wet deposition in forest areas in the Federal Republic of Germany. Final report. Pt. A.** Georgii, H.W.; Grosch, S.; Schmitt, G. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik; Umweltbundesamt, Berlin (Germany, F.R.)). Aug 1986. 237p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Published in 2 volumes.

A network of 7 forest stations was maintained during the period of 1982-1985. The investigation included the evaluation of the dry and wet deposition of the following compounds: H/sup +/ , SO/sub 4//sup 2-/, NO/sub 3//sup -/, Cl/sup -/, Pb, Mn, Fe, Cd, Na, K, Ca and Mg. During a certain period of time also the compounds Al, Cu, Cr and NH/sub 4//sup +/ were analyzed. Measurements of the aerosols and bulk deposition in different levels of the forest stands give information about the influence of spruce stands on the distribution of deposition. Detailed investigation on the composition of fogwater show the importance of fog with respect to the atmospheric input into forest ecosystems. Investigations of ozone at stations in the Taunus area show increasing concentrations with increasing altitudes. The sudden release of accumulated pollutants in snow appearing in the spring time during the thaw is shown. Sequential rain sampling at stations at different altitudes gives information about the contribution of 'rain-out' and 'washout'-processes with respect of the chemical composition of the rain. (orig.) With 55 refs., 20 tabs., 99 figs.

9264 **(UCRL—99882) SLAB: A denser-than-air atmospheric dispersion model.** Ermak, D.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 12p. (CONF-8810240—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003178/JAW.

From Environmental Protection Agency (EPA) workshop on toxic air contamination modeling; San Francisco, CA, USA (17 Oct 1988).

SLAB is a computer model that simulates the atmospheric dispersion of a denser-than-air vapor release. The types of releases treated by the model include an evaporating pool (ground level area source), an elevated horizontal jet, and an instantaneous volume source. Subsequent dispersion of the released vapor is modeled as either a steady state plume, a transient puff, or a combination of the two depending upon the duration of the release. In the case of a finite duration evaporating pool or horizontal jet release, cloud dispersion is initially described using the plume mode while the source is active. Once the source is shut off, subsequent dispersion is calculated using the puff mode. For an instantaneous release, the puff dispersion mode is used for the entire calculation. 5 refs., 1 fig.

9265 **Enhancement of symbiotic dinitrogen fixation by a toxin-releasing plant pathogen.** Knight, T.J.; Langston-Unkefer, P.J. *Science (Washington, D.C.);* **241**: 951-954(19 Aug 1988).

An approximate doubling in plant growth, total plant nitrogen, nodulation, and overall dinitrogen fixation of alfalfa are the consequences of the action of a toxin delivered by a Pseudomonas infesting the alfalfa rhizosphere. The toxin, tabtoxinine-$\beta$-lactam, inactivates selectively one form of glutamine synthetase in the nodules. Thus, normal glutamine synthetase-catalyzed ammonia assimilation is significantly impaired; yet these plants assimilated about twice the normal amount of nitrogen. How plants regulate dinitrogen fixing symbiotic associates is an important and unresolved question; the current results imply that the glutamine synthetase-catalyzed step in ammonia assimilation, a plant function, strongly influences overall dinitrogen fixation in legumes. 26 references, 2 figures, 2 tables.

9266 **Effects of infiltration and insulation on the source strengths and indoor air pollution from combustion space heating appliances.** Traynor, G.W.; Apte, M.G.; Carruthers, A.R.; Dillworth, J.F.; Prill, R.J.; Grimsrud, D.T.; Turk, B.H. (Lawrence Berkeley Lab., CA (USA)). *Journal of the Air Pollution Control Association;* **38**: No. 8, 1011-1015(Aug 1988). Contract AC03-76SF00098.

Many energy conservation strategies for residences involve reducing house air exchange rates. Reducing the air exchange rate of a house can cause an increase in pollutant levels if there is an indoor pollution source and if the indoor pollutant source strength remains constant. However, if the indoor pollutant source strength can also be reduced, then it is possible to maintain or even improve indoor air quality. Increasing the insulation level of a house is a means of achieving energy conservation goals and, in addition, can reduce the need for space heating and thereby reduce the pollutant source strengths of combustion space heaters such as unvented kerosene space heaters, unvented gas space heaters, and wood stoves. In this paper, the indoor air quality trade-off between reduced infiltration and increased insulation in residences is investigated from combustion space heaters. Two similar residences were used for the experiment. One residence was used as a control and the other residence had infiltration and insulation levels modified. An unvented propane space heater was used as the source in this study. A model was developed to describe the dependence of both indoor air pollution levels and the appliance source strengths on house air exchange rates and house insulation levels.

9267 **Climate model simulations of the equilibrium climatic response to increased carbon dioxide.** Schlesinger, M.E.; Mitchell, J.F.B. (Oregon State Univ., Corvallis (USA)). *Reviews of Geophysics;* **25**: No. 4, 760-798(May 1987). Contract AC03-76SF00098.

The first assessments of the potential climatic effects of increased $CO_2$ were performed using simplified climate models, namely, energy balance models (EBMs) and radiative-convective models (RCMs). The feedback processes in RCMs include water vapor feedback, moist adiabatic lapse rate feedback, cloud altitude feedback, cloud cover feedback, cloud optical depth feedback, and surface albedo feedback. However, these feedbacks can be predicted credibly only by physically based models that include the essential dynamics and thermodynamics of the feedback processes. Such physically based models are the general circulation models (GCMs). The earliest GCM simulations of $CO_2$-induced climate change were performed without the annual insolation cycle. The first GCM simulation of the seasonal variation of $CO_2$-induced climate change was performed for a $CO_2$ quadrupling and obtained annual global mean surface temperature and precipitation changes of 4.1°C and 6.7%, respectively. Recently, three $CO_2$-doubling experiments have been performed with GCMs that include the annual insolation cycle. These seasonal simulations give an annual global mean warming of 3.5° to 4.2°C and precipitation increases of 7.1 to 11%. The geographical distributions of the $CO_2$-induced warming obtained by the recent simulations agree qualitatively but not quantitatively. Furthermore, the precipitation and soil moisture changes do not agree quantitatively and even show qualitative differences. In order to improve the state of the art in simulating the equilibrium climatic change induced by increased $CO_2$ concentrations, it is recommended first that the contemporary GCM simulations be analyzed to determine the feedback processes responsible for their differences and second that the parameterization of these processes in the GCMs be validated against highly detailed models and observations.

## 5003 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 7508, 7828, 7831, 7835, 7918, 9264, 9322, 9507, 10532*

9268 **(CEA-DPS—88-07) Dose factors for external irradiation: submersion in a cloud and deposition of radionuclides on a plane source.** Le Grand, J.; Roux, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). 1988. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755991/JAW.

The dose factors are given for 115 radionuclides. That is the kerma rates in air at 0.5 m and 1 m above ground level, for submersion in a semi-infinite cloud and deposition on an infinite plane source. Three types of environment are considered: aquatic, urban and rural. The available elements for the photon contribution to the effective dose are presented and discussed. As example, the effective dose rates due to photons are given for 115 radionuclides above a dry soil in rural environment.

9269 **(EPRI-EM—6122) Evaluation of passive monitors for measuring indoor radon and formaldehyde: Final report.** Fortmann, R.C.; Rector, H.E.; Nagda, N.L. (Electric Power Research Inst., Palo Alto, CA (USA); GEOMET Technologies, Inc., Germantown, MD (USA)). Dec 1988. 120p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004291/JAW.

The performance of passive formaldehyde and radon monitors was evaluated by experimental testing under naturally occurring conditions in two well-instrumented research houses and under highly controlled conditions in a radon exposure chamber. Radon monitors evaluated included alpha track detectors, charcoal canisters, and electret radon monitors. A passive diffusion tube monitor for formaldehyde was evaluated. All three passive radon monitors provided measurements within the US Environmental Protection Agency (EPA)-recommended limits of +-25 percent. In most cases, measurement errors with the passive radon monitors were less than +-15 percent. Precision of the monitors was good, generally +-10 percent or better. Performance of the passive formaldehyde monitors was marginal when duplicate monitors were deployed; triplicate monitors were required to obtain acceptable accuracy. Test results demonstrated that the passive radon monitors are well suited for utility-sponsored measurement programs and for use by homeowners. To obtain optimal performance with passive monitors, quality assurance programs need to be implemented to address factors such as sampling duration, deployment procedures, handling and storage, analysis, and interferences like water vapor adsorption by charcoal canisters. Continued experimental testing and evaluation of new passive measurement technologies, including the electret radon monitors, is recommended because of the potentially widespread use of passive monitors for indoor measurements. 34 refs., 11 figs., 13 tabs.

9270 **(FOA-C—20678-9-2) Resuspension measurements. Seconf half-year 1986.** Bjurman, B.; Finck, R.; Arnsting, R.; DeGeer, L.G.; Jakobsson, S.; Vintersved, I. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1987. 25p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755660/JAW.

The resuspension of radioactive particles has been measured at four different locations in Sweden during the second half year 1986. For Cs-134 and Cs-137, the resuspension was found to be in the order from 4x10/sup -9/ to 3x10/sup -8/ (m/sup -1/) depending on the environment. The highest resuspension value was measured in the town of Stockholm and the lowest value measured in the country above a surface of grass and bare rock. The effect of resuspension is probably depending on local conditions in the order of a few tens of kilometers. Plants, such as coniferous woods, could probably give an essential contribution. Further measurements are required in order to draw more far-reaching conclusions about the mechanisms of resuspension. Measurements on very high volumes of ground level air at eight different locations in Sweden during the second half year 1986 has not revealed one single 'hot' particle. The maximum activity of Ru-106, which could have been present in a collected particle is estimated to 40 Bq and the maximum amount of Ce-144 to 300 Bq. This will not cause any radiation protection problems. Spring farming on dry soils, however, could give rise to high activity particles in the air. A separate investigation of resuspension during farm work has therefore been initiated. (authors).

9271 **(PB—88-248232/XAB) Review of the revised plan for the Idaho radionuclide exposure study. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 Oct 1987. 4p. (SAB/RAC—88/001). NTIS, PC A02/MF A01.

See also DE—88-002573.

The current version of the study plan is of sufficient quality and detail to achieve the study's objective. The conclusion of the committee is due primarily to changes in approaches to sampling and measurement of radionuclides, enhanced use of existing data, and improved use of meteorological information.

9272 **(PB—88-248943/XAB) Review of the Office of Radiation Programs' national radon survey design. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 Oct 1988. 18p. (SAB/RAC—88/002). NTIS, PC A03/MF A01.

The EPA Radiation Advisory Committee found that the document presented a valid approach to designing a national radon survey. In addition, the Committee felt that the study is important from a national health point of view and that all efforts must be made to insure that a survey of high quality is conducted. Major conclusions and recommendations are summarized in the report.

9273 **(PB—89-100838/XAB) Environmental Radiation Data: Report 51, July-September 1987. Final report.** (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Mar 1988. 50p. (EPA—520/5-88/013). NTIS, PC A03/MF A01.

See also PB—88-194832.

Environmental Radiation Data (ERD) is a quarterly report that contains data from the Environmental Radiation Ambients Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available. The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water and milk samples from which environmental radiation levels are derived. Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, stronium, iodine, radium, krypton, and tritium.

9274 **(PB—89-101075/XAB) Industrial-hygiene report of radon daughters in foundries using zirconium sand as a molding agent, July 31, September 30-October 2, 1980.** Bloom, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1985. 36p. (IWS—156.04). NTIS, PC A03/MF A01.

A survey of exposures to radon daughters in foundries using zirconium sand as a molding agent was conducted. The survey was prompted by a report that significant concentrations of uranium- and thorium-decay isotopes were found in zirconium sand. Area air and bulk samples were analyzed for radon-daughter activity in selected operations of five foundries that used zirconium sand as part of the molding aggregate or as a molding agent. One foundry was located in Ohio, the other four were in California. Maximum radon-daughter activity in the area samples ranged from not detectable to 0.023 working level (WL). The OSHA standards for radon-daughter activity is 0.33 WL. No results were available for the bulk samples due to difficulties with the analytical procedures. The author concludes that the measured levels of radon daughter activity in the foundries are extremely low. The potential for a radiological health hazard due to exposure from radon daughters in zirconium sand at this time is very low. Laboratory studies of zirconium sand and a gamma-radiation survey of foundries that use zirconium sand are recommended.

9275 **(PB—89-103667/XAB) Review of the OEETD (Office of Environmental Engineering and Technology Demonstration) radon-mitigation research program. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 14 Jan 1988. 14p. (SAB/RAC—88/009). NTIS, PC A03/MF A01.

See also PB—88-245485.

The EPA Radiation Advisory Committee was very favorably impressed with both the quality and quantity of the Agency's research efforts on radon mitigation. Recommendations were directed towards strengthening the weaker areas in an otherwise very strong program. The Committee also made several recommendations concerning data collection and presentation which should improve consistency and ease of interpretation.

9276 **(PB—89-105019/XAB) Science Advisory Board endorses the range of risks presented by EPA (Environmental Protection Agency) in radon risk estimates. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 Sep 1988. 8p. (SAB/RAC—88/042). NTIS, PC A02/MF A01.

The EPA Science Advisory Board's (SAB) Radiation Advisory Committee endorses the range of risk estimates proposed by EPA's Office of Radiation Programs in Radon Risk Estimates. The Committee recommends EPA not attempt to develop still another model for radon and radon-daughter risk estimation and projection, but urges the use of existing technical consensus reports. Three important technical consensus reports on radon risks are of potential use to EPA. None of these reports is clearly pre-eminent; each has its strengths and weaknesses which reflect the uncertain state of knowledge in particular areas. Two of these reports appear to have greater utility for EPA.

9277 **(PB—89-110035/XAB) Follow-up alpha-track monitoring in 40 eastern Pennsylvania houses with indoor radon-reduction systems (Winter 1987-1988). Final report, December 1987-May 1988.** Scott, A.G.; Robertson, A. (American ATCON, Inc., Wilmington, DE). Sep 1988. 24p. NTIS, PC A03/MF A01.

See also PB—88-156617.

This report gives results of follow-up alpha-track detector (ATD) measurements. The systems involved some form of active soil ventilation, although three involved heat-recovery ventilators and two included carbon filters for removing radon from well water. The reduction in indoor radon concentration achieved in each house was described in an earlier report. The purpose of the ATD measurements was to determine how well the radon-reduction performance of the systems was being maintained. The ATD measurements were scheduled to assess system performance when cold weather would be giving the systems a significant challenge. These 1987-88 ATD results are compared with post-mitigation ATD measurements during the previous winter (1986-87), and with ATD measurements made prior to the installation of the radon reduction systems. Of the 34 houses where radon mitigation was in operation during the entire measurement period, the radon levels measured in 1988 compared well with those measured in 1987 in all but one house, indicating no significant degradation in system performance: in House 10, levels had increased 50-70% from 1987 with no apparent reason.

## 5004 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 9514*

## 5005 Site Resource And Use Studies

9278 **(EUR—11073) 28. 1986 meteorological yearbook of Ispra.** Bollini, G.; Galva, A.; Gandino, C.; Porrati, E. (Commission of the European Communities, Ispra (IT). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1987. 88p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756037/JAW.

After a short description of the methods for measuring and elaborating atmospheric phenomena, many tables and graphics are reported with English titles too for the meteorological year 1986. The measurements of solar irradiation are marked with the final hour, following Italian winter time.

## 5006 Regulations

*REFER ALSO TO CITATION(S) 9243*

**9279 (AD-A—198184/4/XAB) Emission testing of hospital pathological incinerator, Griffiss Air Force Base, New York. Final report for period ending 11 December 1987.** Daly, M.M. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jul 1988. 67p. (USAFOEHL—88-095EQ0079FEF). NTIS, PC A04/MF A01.

At the request of HQ SAC/SGPB, personnel from the USAFOEHL conducted an air-emission survey of the exhaust from the hospital pathological incinerator at Griffiss AFB NY on 11 Dec 88. The survey results show that the facility is in compliance with the State of New York emission standards for particulate matter. The State has proposed revisions to the existing regulations and survey results show that the particulate and hydrogen chloride proposed emission standards would be met. The proposed regulations for minimum-temperature values in the primary and secondary chambers would not be met. The facility is in compliance with the existing particulate-matter standards and no further action is required. The facility is not in compliance with the proposed standards due to the temperatures in the primary and secondary chambers. Action is recommended to correct this situation, although, based on the proposed revision to the regulations, compliance will not be required until January 1, 1992.

**9280 (PB—88-249107/XAB) Love Canal Emergency Declaration Area habitability study. Volume 1. Introduction and decision-making documentation. Final report.** (Life Systems, Inc., Cleveland, OH (USA)). May 1988. 83p. NTIS, PC A05/MF A01.

See also Volume 2, PB—88-249115; Also available in set of 5 reports PC E99, PB—88-249099.

Environmental studies were conducted to provide data that could be used by the Commissioner of Health for the State of New York in determining whether the Emergency Declaration Area surrounding the Love Canal hazardous-waste site is habitable. Volume I of the five-volume series summarizes the main elements and the key decision points in the Habitability Study as an introduction to the series.

**9281 (PB—88-251251/XAB) Recommendations for future research on national ambient air-quality standards for ozone and lead. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 30 Sep 1987. 38p. (SAB/CASAC—87/036). NTIS, PC A03/MF A01.

The research recommendations for ozone are presented in three parts: (1) atmospheric chemistry; (2) health effects; and (3) agriculture, forests, and related ecosystems. Each part is critical to setting an ozone NAAQS. The latter two areas are critical in establishing exposure-response relationships for the effects that ambient ozone produces. However, without a better understanding of exposure profiles, scientists and regulators cannot accurately establish the extent of the effects of ambient ozone exposure on public health and welfare. Without a better understanding of atmospheric chemistry, the frequency of excessive exposures or the influence of the various sources of the ozone precursors cannot be predicted.

**9282 (PB—88-870431/XAB) Polymeric materials combustion: toxicity hazards and legal aspects. January 1976-October 1988 (Citations from the Rubber and Plastics Research Association data base). Report for January 1976-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 100p. NTIS PC N01/MF N01.

Supersedes PB—87-868659.

This bibliography contains citations concerning toxicity hazards and legal aspects of polymeric materials combustion in building, electrical, and electronic applications. Flammability assessment, flame-retardant additives, and toxicity standards of polymeric materials are discussed. Regulations and legislation on polymer flammability are presented. Health hazards caused by toxic gasses from polymeric materials combustion are considered. (This updated bibliography contains 210 citations, 14 of which are new entries to the previous edition.)

**9283 (PB—89-103691/XAB) Control of open fugitive dust sources. Final report.** Cowherd, C.; Muleski, G.E.; Kinsey, J.S. (Midwest Research Inst., Kansas City, MO (USA)). Sep 1988. 344p. NTIS, PC A15/MF A01.

The purpose of this document is to provide State and local regulatory personnel with sufficient information to develop control plans for open dust sources of PM-10, covering paved roads, unpaved roads, storage piles, construction/demolition activities, open-area wind erosion, and agricultural tilling. Each chapter begins with an overview of the source category describing emission characteristics and mechanisms, followed by available emission factors for analyzing the operative nature of control measures. Demonstrated control techniques are discussed for estimating efficiency and determining costs of implementation. Suggested regulatory formats provide arguments used in implementing the technical discussions in viable regulations and compliance actions. Example regulations for each source category are presented in an appendix.

**9284 (PB—89-104996/XAB) Regulatory impact and regulatory flexibility analysis of the final standard for ethylene oxide.** (Occupational Safety and Health Administration, Washington, DC (USA)). 18 Jun 1984. 189p. (OSHA/IS—88/007). NTIS, PC A09/MF A01.

Executive Order 12291 (46 FR 13197, February 19, 1981) requires that a regulatory analysis be conducted for any rule having major economic consequences on the national economy, individual industries, geographic regions, or levels of government. The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) similarly requires the Occupational Safety and Health Administration (OSHA) to consider the impact of the regulation on small entities. The report addresses the regulatory analysis for ethylene oxide.

**9285 (PB—89-105001/XAB) Preliminary industrial-hygiene survey of Tuffy Service Center, Sharonville, Ohio, August 12, 1976.** Johnson, P.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1978. 21p. (IWS—032-55). NTIS, PC A03/MF A01.

Worker exposure to asbestos were surveyed on August 12, 1976, at Tuffy Service Center (SIC-7539) in Sharonville, Ohio. The number of employees was not reported. General area air samples contained 0.008 to 0.02 fibers of asbestos greater than 5 microns per cubic centimeter (f/cc), well below the OSHA Standard of 2.0 f/cc. The author notes that a potential does exist for hazardous exposure to asbestos, and recommends strict compliance with OSHA Standards for handling abestos.

**9286 (PB—89-109060/XAB) BACT/LAER (Best Available Control Technology/Lowest Achievable Emission Rate) Clearinghouse: a compilation of control-technology determinations. Third supplement to 1985. Summary Tables and Appendices A-G.** (PEI Associates, Inc., Cincinnati, OH (USA)). Jul 1988. 683p. NTIS, PC A99/MF E04.

See also report dated Jun 1987, PB—87-220596.

The basic purposes of the BACT/LAER Clearinghouse are to: (1) provide State and local air-pollution control agencies with current information on case-by-case control technology determinations that are made nationwide; and (2) promote communication, cooperation, and sharing of control-technology information among the permitting agencies. The information presented in the compilation was abstracted from preconstruction permits and submitted voluntarily by the State and local air-pollution control agencies. The Clearinghouse is intended as a reference for State and local agencies in making BACT/LAER decisions. The report is a supplement to previous Clearinghouse compilations issued in May 1982, April 1983, May 1984, May 1985, May 1986, and May 1987.

**9287 (PB—89-114110/XAB) Magnetic tape manufacturing industry: background information for promulgated standards. Final environmental impact statement.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1988. 95p. (EPA—450/3-85/029B). NTIS, PC A05/MF A01.

See also PB—86-156791.

Standards of performance for the control of VOC emissions from magnetic-tape manufacturing lines are being promulgated under authority of Section 111 of the Clean Air Act. These standards apply to all new magnetic tape coating lines using at least 38 cubic meters of solvent per year (cu m/yr) in the production of magnetic tape and to all modified and reconstructed magnetic-tape coating lines using at least 370 cu m/yr in the production of magnetic tape. The document contains a summary of the public comments on the proposed standards and EPA's responses, as well as summary economic and environmental impact statements.

9288 **(PB—89-114128/XAB) Draft risk-screening analysis of mining wastes. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 26 Apr 1988. 35p. (SAB/EEC—88/028). NTIS, PC A03/MF A01.

The Mine Waste Risk Screen Subcommittee of the EPA Science Advisory Board's Environmental Engineering Committee concluded that the general risk-screen approach for analysis of mining waste is appropriate and the risk-screen methodology can be used for setting priorities for collection of additional data when all appropriate pathways and component models are implemented. The Subcommittee recommended that, while the model may be appropriate, it should not, in its current state, be used to provide a context for performing analyses that may lay out options for the scope of the regulatory approaches for managing mining wastes. The Subcommittee identified additional pathway receptor combinations approach is conceptually sound and the air emission factors are appropriate for the present state of development of the risk screen analysis.

# 51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

*REFER ALSO TO CITATION(S) 9142*

## 5101 Basic Studies

*REFER ALSO TO CITATION(S) 8801, 9339*

9289 **(CRIE-U—87059) Simularity of model experiments on onshore-offshore beach profile change.** Shimizu, Takao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1988. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01 - Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo. Order Number TI88755725/JAW.

As a part of the estimation method of beach profile change and the design method of beach maintenance work, the similarity of a mobile bed model experiment was investigated. Based on sediment transport derived from a asymmetric oscillatory component of bottom current due to wave shoaling and a seaward steady component due to wave breaking, the influences of a offing waveform gradient, seabottom gradient and bed material diameter on beach erosion-accretion were clarified. Applying the result to the feature that a bottom friction coefficient affected by wave and current increases with scale-down, the scale effect that a beach profile changes erosionally and a critical change depth of water increases was derived. Comparing the results of a middle scale onshore-offshore beach profile change experiment with the previous results of large scale wave flume experiments and small scale experiments, the scale effect was confirmed and evaluated quantitatively. Consequently, the particle scale of bed material and time scale of profile change were determined for a similar model experiment of onshore-offshore beach profile change. (25 figs, 6 tabs, 35 refs)

9290 **(PB—89103188/XAB) Methodology for assessing respiration and cellular incorporation of radiolabeled substrates by soil microbial communities (journal version).** Dobbins, D.C.; Pfaender, F.K. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). 1988. 19p. NTIS, PC A03/MF A01.

Pub. in Microbial Ecology, Vol. 15, No. 3, 257-273(May 1988).

A method is described for determining biodegradation kinetics of both naturally occurring and xenobiotic compounds in surface and subsurface soil samples. The method measures both respiration and uptake into cellular biomass of 14C-labeled substrates. After separation of the cells and the soil particles by centrifugation, the cells were trapped on membrane filters for liquid scintillation counting. Mass balances were easily obtained. The technique was used to measure metabolic activity in soil profiles, including unsaturated and saturated zones. First-order rate constants were determined for amino acid metabolism and for m-cresol metabolism. Saturation kinetics were observed for amino acids and m-cresol. m-Cresol values for uptake often exceeded those for respiration by greater than a factor of ten. Saturation was not observed in many horizons. Frequently, respiration obeyed saturation kinetics, whereas uptake was first order. It is concluded that measuring only kinetics of respiration may lead to severe underestimations of biodegradation rates.

9291 **Comparison of two methods of counting birds at sea.** Powers, K.D. *Journal of Field Ornithology;* **53**: No. 3, 209-222(1982). Contract AC02-78EV04706.

In an attempt to improve techniques for surveying marine birds, the author compares methods for estimating relative abundance and density. Quantitative relationships exist between estimates of relative abundance and density for most marine bird species. Estimates of abundance can be derived from values of density by regression models when the following factors are considered: bird behavior (flying, sitting, and ship-following), duration of the count, and ship speed. The author's data suggest a minimum numerical relationship of 2:1 between estimates of abundance and density for sitting birds and 1:1 for flying birds. Neither method of counting birds at sea eliminates the problem of ship-followers. However, the density method minimizes an inflationary effect caused by ship-followers that is apparent with the abundance estimate, especially when the observer's vessel is associated with fishing activities. Differences in abilities of observers to count birds is a principal, but unavoidable, source of variability with both counting methods. The density method also minimizes this problem by focusing the observer's view in an area with known boundaries. This standardization decreases variability in bird detection due to weather, size and color differences between species, flock sizes, and bird behavior. These factors are not controlled in estimates of abundance.

## 5102 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7241, 7242, 7543, 7545, 7594, 7595, 7597, 7890, 7891, 8054, 9325, 9348, 9350, 9352, 9368, 9378, 9449, 9520, 9529, 9532, 9533, 9534, 9535, 9536, 9578, 9583*

9292 **(AD-A—197892/3/XAB) Installation-restoration program. Phase 2. Confirmation/quantification. Stage 1. Reese Air Force Base, Lubbock, Texas. Volume 1. Technical report. Final report, May 1986-April 1988.** (Ecology and Environment, Inc., Lancaster, NY (USA). Buffalo Corporate Center). 14 Apr 1988. 180p. NTIS, PC A09/MF A01.

See also Volume 2, AD-A197 562.

Ecology and Environment, Inc., was retained by the USAFOEHL/TSS to provide technical and analytical services in support of the Air Force IRP. These services were applied to the Phase II, Stage 1, investigation of Reese AFB, Lubbock, Texas. The field investigation was conducted from June 24, 1986 to October 31, 1986, and involved work at nine areas at the base. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils, ground water and surface water. Samples were analyzed for various parameters including volatile organics, oil and grease, pesticides, herbicides, petroleum hydrocarbons, primary metals, phenols, PCBs, and polynuclear aromatic hydrocarbons. Results of the investigation indicated that past waste handling and disposal practices had caused various degrees of soil and groundwater contamination.

9293 **(AD-A—199116/5/XAB) Feasibility study of contamination remediation at Naval Weapons Station, Concord, California. Volume 1. Remedial-action alternatives. Final report.** Cullinane, M.J.; Lee, C.R.; O'Neil, L.J. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Sep 1988. 882p. (WES/MP/EL—86-320). NTIS, PC A99/MF E04.

This report identifies and describes potential remedial actions to eliminate or mitigate the release of hazardous substances onto lands of the Naval Weapons Station, Concord, CA. Hazardous substances identified as necessitating remedial actions include lead, cadmium, zinc, copper, selenium, and arsenic. The proposed remedial actions are designed to address existing or potential impacts identified in a separate study. These identified impacts include: contamination of soil with metals; contamination and toxicity in plants and soil invertebrates; reduced plant growth; increased soil acidity; surface water contamination; air contamination; loss of quantity and quality of wildlife habitat; loss of wetland function; and loss of ultimate land use. The release of hazardous substances at seven sites was identified in the remedial investigation. The seven individual areas were consolidated into four remedial action subsites (RASS's) based on an analysis of the topography and nature of the habitat.

9294 **(AD-A—199298/1/XAB) Oceanographic and climatological atlas of Bristol Bay. Final report.** Wise, J.L.; Leslie, L.D.; Labelle, J.C. (Alaska Univ., Anchorage (USA). Arctic Environmental Information and Data Center). Oct 1987. 192p. NTIS, PC A09/MF A01.

This is a reference document of oceanography, meteorology, sea ice, and climatology. It was prepared for use by the U.S. Coast Guard on-scene coordinator in the event of an oil spill in Bristol Bay at any time. The oceanography section contains information for bathymetry, circulation, water temperature and salinity, waves, tides, river discharge, and oil spill transport. The meteorology section includes seasonal weather and storm tracks, storm surges, superstructure icing, and wind chill. Climatology includes graphs and test on temperature, precipitation, wind, visibility, and cloudiness. Ice information includes seasonal formation and drift, concentration, thickness, nearshore ice, and freeze-up and breakup dates.

9295 **(CRITE-T—87056) Transport of solutes from coal ash through soil (2nd report). Movement and neutralization of alkaline leachate.** Matsubara, Akio; Sato, Kazuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1988. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755738/JAW.

A model was developed to estimate the change of pH in the process in which alkaline leachate from coal ash permeates the soil. The rate of travel of hydroxide ion (OH) in the soil was analyzed by the model. Humus in the soil mainly contributes to the neutralization of alkali. The column experiment reveals that OH moves to the downstream before it is completely consumed in the soil when the flow speed of water permeating the soil is high, while OH is thoroughly consumed in the land filled up with coal ash where the flow speed of water permeating the soil is as low as less than 1 m/year. The calculation result obtained using the model indicates that pH of underground water flowing through channels below the 1 m-thick soil layer overlaid with coal ash scarcely increases. When the flow speed of water permeating the soil is sufficiently low, the range of alkali leachate can be estimated using an equation derived from the mass balance of OH. (8 figs, 5 tabs. 24 refs.)

9296 **(ESSA—8703) Interim target loadings for acidic deposition in western Canada: a synthesis of existing information. Final report.** (Essa Environmental and Social System Analysts Ltd., Victoria, British Columbia (Canada)). 1987. 276p. (MICROLOG—88-02717). National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, Ont., Canada K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The maximum level of atmospheric deposition that affords long-term protection from adverse ecological consequences to all but the most sensitive portions of the ecosystem has been called the target loading. Establishment of a target loading to protect ecosystems involves scientific research on atmospheric pollutants and biotic receptor sensitivity, and risk analysis evaluating the dose-response relationship beween pollutant concentrations and biotic effects. The purpose of this report is to present the results of relevant scientific analyses of acidic deposition in western Canada, notably in order to assist policymakers in the formulation of target loadings. The first part of this report summarizes the history of concern about acid precipitation in western Canada and reviews the methods that have been used to define target loadings. Later parts describe sources and concentrations of important air pollutants as well as the adequacy of existing databases for estimating pollutant loadings. The potential for application of these methods, and others, to western Canada is examined in considerable detail. Three of the major issues of concern are the feasibility of using wet deposition of sulfate as a measure of acid loading, the lack of appropriate methods and data for defining target loadings to terrestrial systems, and the uncertainty in the aquatic resource at risk within each region. Approaches are suggested for research in determining target loadings for the various ecological regions. 188 refs., 29 figs., 32 tabs.

9297 **(HC—EE-99) A person portable analytical system for the determination of polychlorinated biphenyls.** Ruttan, J.T. (Hatfield Consultants Ltd., West Vancouver, British Columbia (Canada)). 1988. 81p. (MICROLOG—88-03666). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A field usable, person portable analytical system for the termination of polychlorinated biphenyls (PCBs) in oil, water and soil, and from solid surfaces (such as concrete, asphalt, and wood) has been developed. The test used in this system is based on the quantitative conversion of the chlorine atoms in chlorinated organic compounds to chloride ions. These ions are then extracted into an aqueous solution and measured by titrimetric means. The lowest limit of detection for Aroclor 1260 in oils using this titrimetric test has been determined to be 15 ppM and 35 ppM in soils. The highest detection limit determined has been greater than 35,000 ppM. This method has an analysis time of less than 20 minutes and requires no sample preparation. It is non-specific in identifying Aroclor types, and chlorinated organic compounds, other than PCBs, can interfere with the chemical reactions. 73 refs., 10 figs., 14 tabs.

9298 **(KFK-PEF—35-Vol.1) Fourth annual report of the European Research Centre for Air Pollution Control Measures.** Horsch, F.; Filby, W.G.; Fund, N.; Gross, S.; Hanisch, B.; Kilz, E.; Seidel, A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1988. 375p. (In German). (CONF-8803158—Vol.1). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW.

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

During the 8-10th of March 1988 the Fourth Status Report of the Project 'European Research Centre for Air Pollution Control Measures' took place at the Nuclear Research Centre Karlsruhe. From this report 31 progress reports on the topic assessment and analysis of the impacts of airborne pollutants on forest trees; distinction from other potential causes of recent forest dieback were presented.

9299 (KFK-PEF—35-Vol.1, pp 27-38) **Project ARINUS: 2. establishment of the measuring equipment and testing phase.** Feger, K.H.; Zoettl, H.W.; Brahmer, G. (Freiburg Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrungslehre). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In 3 adjacent watersheds water and element fluxes are determined by measuring open land precipitation, canopy throughfall, litterfail, and soil seepage water at 3 depths. Cation-anion-balances

of the first half-year of measurement demonstrate a distinct chemical alteration of precipitation passing through the bio-, pedo- and lithosphere. Precipitation shows only a slight to moderate impact of air pollution. Dissolved organic matter highly influences the pH-values and the mobility of potentially toxic aluminum. A simplified Al-fractionation exhibits a high portion of nontoxic organic complexes. The composition of seepage water in the upper soil is mainly controlled by biological processes is plant uptake, mineralization and microbial immobilization. Adsorption and weathering processes in the subsoil and bedrock play the key roles in SO/sub 4//sup 2-/ retention and buffering of acids.

9300 (KFK-PEF—35-Vol.1, pp 39-48) **Ion balances of organic layers and mineral soil horizons after forest fertilizations.** Hildebrand, E.E. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In laboratory experiments with undisturbed soil cores, processes of ion adsorption and -desorption, which were triggered off in different soil horizons by fertilizing neutral salts. (MgSO/sub 4/, K/sub 2/SO/sub 4/), were studied by the means of ion balances. It could be shown, that in a typical 'Pseudogley-Braunerde' on sandy triassic covering (Oberer Buntsandstein) in the Northern Black Forst (FRG) practically no SO/sub 4//sup 2-/-storing in the soil occurs. This causes a transport gradient for soil originating cation-acids which then compensate the SO/sub 4//sup 2-/-anion in the soil pore solution. More than 5 keq ha/sup -1/ acid equivalents leave the rhizosphere in the drainage water, 90% of them consist of Al/sup 3+/. Fertilizing of acid soils with neutral salts enriches the base saturation of acid top soils by increasing the buffering load of deeper horizons or charges the hydrosphere. Acidification thus becomes more irreversible.

9301 (KFK-PEF—35-Vol.1, pp 49-60) **Acidification of soil and water and input-output-balance of various catchments and components of drain in the Northern Black Forest.** Einsele, G.; Ehmann, M.; Irouschek, T.; Seeger, T. (Tuebingen Univ. (Germany, F.R.). Geologisches Inst.). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

This is a brief report of comprehensive soil water and catchment studies carried out during the last three years in the forested Bunter Sandstone of the Black Forest. For example individual ionic balance calculations for separate compartments reveal leaching or storage processes in the canopy, the soil, periglacial debris layer and finally in the deeper aquifer. Aluminum, which is dissolved in the upper soil, is already partly precipitated as AlOHSO/sub 4/ at a depth of 25-40 cm. The sulphate concentration in seepage water is a direct result of the sulphate contained in precipitation. As far as the cations are concerned, it was found, that no equilibrium could be reached with the CEC nor with soluble salts. The porewater, generally shows higher ionic concentrations than the seepage water. It also controls the soil pH. In spring, low nitrate concentrations seem to correspond to high pH values. In the aquifer itself the changes in the water chemistry are negligible. The fluxes of calcium and magnesium generally exceed their input. Assuming constant fluxes, calcium can be expected to have disappeared by the end of a hundred to two hundred years. Mass balance calculations of the inorganic chemical components within the hydrological cycle are presented. The nutritional demands of plants is probably covered by the atmospheric input. Taking into account the internal transfer of nutrients within the system, the only significant storage of inorganics in the soil is found in the case of sulphate ions.

9302 (KFK-PEF—35-Vol.1, pp 61-73) **Investigation to the material deposition in natural forest ecosystems of Baden-Wuerttemberg.** Buecking, W.; Steinle, R. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In Baden-Wuerttemberg the deposition of air pollutants in forest ecosystems was predominantly studied in commercial forests of simple structure. As part of the project 'Investigation to the condition of the trees and the material deposition in natural forest ecosystems' the following paper deals with the influence of uneven aged and multilayered stands on deposition phenomena. Three natural forest reserves were selected, observed and equipped with bulk samplers, suction cups, stem flow grooves and liter frames for measuring the input. Deposition in commercial forests and unwooded areas act as the control. First results indicate, that stand structure influences the deposition rate and distribution.

9303 (KFK-PEF—35-Vol.1, pp 85-101) **Succession of ground-vegetation indicating possible ecological consequences of the forest-decline. Comparison of earlier phytosociological surveys with the actual status of ground vegetation in affected forests of the Black Forest.** Buerger, R. (Freiburg Univ. (Germany, F.R.). Inst. fuer Landespflege). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

During the years 1985 and 1986 phytosociolocial surveys were taken in affected stands of the most common forest-communities in the Black Forest. Compared to earlier releves, an increase in the average number of species was observed in all forest types. The composition of species has changed towards an increased percentage of underwood and felled-area flora, accompanied by few heath species. These changes result in an increased mean value for soil-reaction as well. The mean value for light-indication has also increased. The spectrum of indication-values for each type of forest Community permits a better specification of the changes mentioned above.

9304 (KFK-PEF—35-Vol.1, pp 123-133) **Scolytid-species as emmission indicators for toxic elements.** Roth-Holzapfel, M.; Funke, W. (Ulm Univ. (Germany, F.R.). Abt. Oekologie und Morphologie der Tiere). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In two Scolytid-species (Ips typographus and Trypodendron lineatum) the concentrations of 13 elements, mainly heavy metals, were determined: Al, Ba, Ca, Cd, Cu, Hg, K, Mg, Mn, Pb, Tl, Zn. Samples were collected by pheromone traps from 19 sites in Baden-Wuerrtemberg with different degrees of pollution. Irrespective of anthropogenic contamination of sample site, there was good agreement in the quantitative amounts of Ca, Cu, K, Mg, Mn and Zn in all individuals. No regional differences were found. In opposition to the homogenous amounts of these elements great differences - in dependence of sample site - were established for Fe and elements with well known toxic impacts on ecosystems (Al, Ba, Cd, Hg, Pb). The highest levels of toxic heavy metals were found in Scolytids collected nearby Heidelberg-Mannheim, a region with high atmospheric input of inorganic pollutants. The significance of Scolytids as indicators of heavy metal burden is discussed on the base of these results.

9305 (KFK-PEF—35-Vol.1, pp 135-149) **Comparative investigations on animal cenuses of spruce and deciduous forests and of an old orchard - soil animals as bioindicators.** Funke, W.; Herlitzius, H.; Jans, W.; Kraniz, V.; Lehle, E.; Ratajczak, L.; Stumpp, J.; Vogel, J.; Wanner, M. (Ulm Univ. (Germany, F.R.). Abt. Oekologie und Morphologie der Tiere). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Investigations were carried out on Protozoa (Testacea, Ciliata) and Metazoa (Nematode, Annelida, Arthropoda) esp. of spruce stands. For comparisons deciduous forests and an old orchard were also used. In enchytraeid worms and in arthropods, esp. in dipterous imagines, liming and fertilizing of soil surface (in 1984/1984) had brought strong negative effects in regard of population density in the last years. Since 1987 these effects seem to turn into the opposite direction. Earth worms are naturally promoted by liming and fertilizing. Contaminations of soil surface by solutions of NaCl or by H/sub 2/SO/sub 4/ (in 1985) yielded considerable after-effects even 18 months later in a nematod worm coenosis, if comparisons are made with the data of control areas. In edaphic springtails, species numbers, abundances and diversities of coenoses now had nearly normalized (two years after the contaminations). But negative effects after contaminations with the synthetic pyrethroid Cypermethrin (Ripcord) seem to be unchanged up to now.

9306 (KFK-PEF—35-Vol.1, pp 245-254) **Water-, needle- and soil-analytical investigations as a part of the experiments with open top chambers in the Edelmannshof/Welzheimer forest.** Evers, F.H. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Crown throughfall taken under spruce growing in open top chambers supplied with unfiltered air is much more acid than throughfall taken from trees growing under the same conditions but supplied with filtered (clean) air. The proton input is approximately 5.5 times higher under unfiltered than under clean air conditions. Concentrations of sulfate (SO/sub 4//sup 2-/) and nitrate (NO/sub 3//sup -/) are 1,5 to 2,8 times higher for the unfiltered air. Measurements outside of the open top chambers show even higher values. For chloride (Cl/sup -/) no differences in both cases could be found. The higher amounts of anions (NO/sub 3//sup -/, SO/sub 4//sup 2-/) are accompanied by cations like calcium (Ca/sup 2+/), magnesium (Mg/sup 2+/), ammonium (NH/sub 3//sup +/) and zinc (Zn/sup 2+/). Obviously, these cations are much easier leached with unfiltered air. These findings are more clear during winter than in the vegetation period, except K/sup +/, potassium becomes dissolved in high rates even in summer. Presumably, most of it originates from young needles. Correlations between ion concentrations from crown throughfall and soil solution have not been found yet.

9307 (KFK-PEF—35-Vol.1, pp 311-321) **Lachnids as bioindicators.** Liebig, G. (Hohenheim Univ., Stuttgart (Germany, F.R.). Landesanstalt fuer Bienenkunde). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The influence of the weather on the forest decline is estimated contrarily. The results of long standing field studies about the population dynamics of the green striped fir lachnid Cinara pectinatae show, that the population trend is suitable to indicate the physiological condition of firs. Changes in population density are caused especially by changes in physiological condition, which are dependent on the weather (especially of autumn and spring) or on the fir decline.

9308 (KFK-PEF—35-Vol.1, pp 323-346) **Review of the terrestrial and airborne forest damage survey methods, of information systems and growth analysis techniques.** Tzschupke, W. (Staatliches Forstamt, Freudenstadt (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Informations on the extent, the regional occurrence and the development of the forest decline are important preconditions for an appropriate research on the causes of the forest damages as well as for political, administrative and operational countermeasures. The following review refers to three special aspects of this general information problem: Assessment of macroscopic forest damage symptoms by special inventories, assessment and analysis of supposed growth-losses, combination of these informations with other relevant datas within information-systems. Forest yield research has developed qualified techniques for the assessment of the growth and increment of forest-trees and forest stands since several decades. At the moment three growth references are proposed and discussed: The so called couple comparison, the use of yield-tables and/or growth data, collected in former times within special test sites, and so called synthetic reference curves. Independent of the above mentioned methodological problems all growth investigations indicate a rather strong correlation between the increment and the needle- or leafmass of the examined trees.

9309 (KFK-PEF—35-Vol.1, pp 347-359) **Combination and interpretation of forest damage and stand conditions with the aid of a geographic data base system.** Saurer, H.; Gossmann, H.; Baehr, H.P.; Behr, F.J. (Wuerzburg Univ. (Germany, F.R.). Inst. fuer Geographie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Photogrammetrie und Fernerkundung). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In the context of the project 'Development of a geographic information system for investigation and monitoring of forest decline' multiple layers of information (forest damage, tree species, DTM, soils, geology etc.) were integrated in a raster based GIS for digital processing and evaluation. Forest damage and tree species data of three different scales are available within this project. The dataset about 25 m x 25 m is deduced from aerial CIR photographs. This work has been done by the 'Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg'. To enable combination with other geocoded characteristics rectification to a common ground coordinate system had to be performed. For rectification of this data three methods were developed and implemented. In this paper the rectification methods are reviewed briefly and the accuracy obtained is reported. The dataset was processed with other GIS layers (settlements, rivers, lakes, roads) for cartographic output and combined with site conditions like elevation, slope, aspect and stand characteristics like age, density and stand type.

9310 (KFK-PEF—35-Vol.1, pp 361-370) **Small scale inventory procedures for the assessment of forest damage in small areas.** Dees, M.; Pelz, D.R. (Freiburg Univ. (Germany, F.R.). Abt. fuer Forstliche Biometrie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Forest damage inventories are being conducted since several years, mainly as large scale inventories. For small areas inventory methods have to be developed for an improved diagnosis and to provide base line data. Two districts have been inventoried, the city forest of Freiburg and in the Muellheim district, in addition stands were generated with random and aggregate distributions for computer simulation studies. Plot size and density were studied. For estimating the average needle loss a small sample size is

needed, for simultaneous estimation of the proportions of several damage classes a larger sample size is required. Special problems with small area forest damage inventories include the objectivity of estimating damage, determining the optimal sample size and the statistical evaluation. Several alternatives are being discussed.

9311 **(PB—88-249842/XAB) Evaluation of technologies for treating aqueous metal/cyanide bearing hazardous waste (f007).** Grosse, D.W.; Hassan, S.Q.; Vitello, M.P.; Koczwara, M.K. (Cincinnati Univ., OH (USA). Dept. of Civil and Environmental Engineering). Aug 1988. 18p. NTIS, PC A03/MF A01.

As a result of recent developments in the area of hazardous-waste management, the U.S. Environmental Protection Agency is evaluating the performance of various technologies for the treatment and/or destruction of certain wastes that are presently being disposed of in landfills and surface impoundments. As a part of this program the University of Cincinnati, at the U.S. EPA Test and Evaluation Facility in Cincinnati, Ohio, is testing existing treatment technologies that are applicable to metal- and cyanide-bearing hazardous wastes. The following unit processes were evaluated: alkaline chlorination, precipitation, filtration, anion exchange, and cation exchange. Results of the studies are presented.

9312 **(PB—88-251806/XAB) Mobilization of aluminum in a natural soil system: effects of hydrologic pathways.** Cozzarelli, I.M.; Herman, J.S.; Parnell, R.A. (Virginia Univ., Charlottesville (USA). Dept. of Environmental Sciences). 1987. 18p. NTIS, PC A03/MF A01.

Pub. in Water Resources Research, Vol. 23, No. 5, 859-874(May 1987).

A two-component soil/water flow model was used with an equilibrium speciation model WATEQF to study aluminum mobility in soils of a forested watershed. Analysis of soil-solution samples showed that aluminum concentrations decreased with depth. All waters contained acid-soluble aluminum and exhibited a negative correlation between pH and the inorganic monomeric aluminum concentrations. Water in the shallow soil showed different chemical compositions for the two flow types, while C horizon micropore and macropore waters were similar. Because of its shorter residence time, water flowing in deep soil macropores underwent less-extensive neutralization and immobilization of aqueous aluminum than micropore water.

9313 **(PB—88-251871/XAB) Hazardous waste from small-quantity generators in the United States.** Herndon, R.C.; Moerlins, J.E.; Teaf, C.M.; Lambou, V.W.; Koutsandreas, J.D. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). 1988. 11p. (EPA—600/D-88/193). NTIS, PC A03/MF A01.

Pub. in Hazardous Waste: Detection, Control, Treatment, 943-951(1988).

The EPA must evaluate the potential impact of small-quantity-generator hazardous waste on groundwater contamination in the United States, focusing on potential groundwater contamination due to small-quantity-generator hazardous-waste disposal in municipal sanitary landfills. Data were analyzed from approximately 20,000 small-quantity hazardous-waste generators located within all 67 counties in the State of Florida. The Florida data provide a useful representation of the hazardous-waste generation and management practices of small quantity generators in the United States. The small-quantity-generator hazardous-waste study described has identified the types of waste that pose a potential threat to groundwater in the State of Florida.

9314 **(PB—89-103196/XAB) Microbial removal of halogenated methanes, ethanes, and ethylenes in an aerobic soil exposed to methane. (journal version).** Henson, J.M.; Yates, M.V.; Cochran, J.W.; Shackleford, D.L. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). 1988. 11p. (EPA—600/J-88/066). NTIS, PC A03/MF A01.

Pub. in FEMS Microbiology Ecology, Vol. 53, No. 3-4, 193-201(May/Jun 1988).

Contamination of ground water with halogenated aliphatic hydrocarbons threatens the source of drinking water. To study microbial processes that may enhance the removal of these compounds, Lincoln fine sand was exposed to an atmosphere containing methane (4%) to enrich microorganisms capable of growth on the gaseous hydrocarbon. Removal of dichloromethane, trans-1,2-dichloroethylene, chloroform, 1,2-dichloroethane, trichloroethylene, and 1,1,1-trichloroethane was significantly different in methane-enriched soil compared to non-enriched soil (ANOVA, 95% significance level). Tetrachloroethylene was not removed. Autoclaving the methane-enriched soil inhibited completely the removal of all the compounds. These results suggest that methane stimulation of microbial communities may be an alternative treatment technology for bioremediation of contaminated subsurface soils and ground water.

9315 **(PB—89-103204/XAB) Aerobic biodegradation of natural and xenobiotic organic compounds by subsurface microbial communities.** Swindoll, C.M.; Aelion, C.M.; Dobbins, D.C.; Jiang, O.; Long, S.C. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). 1988. 11p. NTIS, PC A03/MF A01.

Pub. in Environmental Toxicology and Chemistry, Vol. 7, No. 4, 291-299(Apr 1988).

Studies were conducted to characterize the diversity of degradative abilities of microbial communities from pristine aquifer solids samples. Biodegradation was measured in aquifer solids slurries as both the conversion of radiolabeled substrate to $^{14}CO_2$ and the incorporation of label into cell biomass. The microbial community degraded aniline hydrochloride, chlorobenzene, p-chlorophenol, m-cresol, ethylene dibromide, naphthalene, phenol, toluene, and trichlorobenzene. Several kinetic parameters were calculated from the uptake and mineralization data. The results show that uptake into cell biomass represents a large fraction of total metabolism for many of the xenobiotic compounds.

9316 **Effects of leading and whole-tree harvesting on cation budgets of several forests.** Johnson, D.W.; Kelly, J.M.; Swank, W.T.; Cole, D.W.; Van Miegroet, H.; Hornbeck, J.W.; Pierce, R.S.; Van Lear, D. (Oak Ridge National Lab., TN (USA)). *Journal of Environmental Quality;* **17**: No. 3, 418-424(Jul-Sep 1988). Contract AC05-84OR21400.

The effects of acid deposition, natural leaching, and harvesting on base cation export from forests in Maine, Tennessee, South Carolina, North Carolina, and Washington were compared. Based on previous literature, the authors hypothesized that base cation export via whole-tree harvesting (WTH) would be nearly independent of soil exchangeable base cation supplies; base cation export via leaching would be strongly dependent on the exchangeable cation supplies as well as the input, production, and mobility of anions. This hypothesis was supported by the data: mixed deciduous sites in Tennessee had among the highest base cation (principally Ca) exports via WTH (1.2 kmol/sub c/ $ha^{-1}$ $yr^{-1}$), yet the lowest soil exchangeable supplies (35 kmol/sub c/ $ha^{-1}$), whereas the Washington sites had by far the highest base cation leaching (5-41 kmol/sub c/ $ha^{-1}$ $yr^{-1}$, due to very high levels of naturally produced $HCO_3^-$) and soil exchangeable supplies, yet only relatively moderate base cation exports via WTH (0.4 kmol/sub c/ $ha^{-1}$ $yr^{-1}$). Sulfate was either the dominant or a major anion in the soil solutions from the eastern sites, suggesting that atmospheric deposition was a major factor in soil leaching from these sites (0.2-2.1 kmol/sub c/ $ha^{-1}$ $yr^{-1}$), but total leaching rates from these sites were much lower than at the Washington sites. Indeed, some of the eastern sites showed a net annual accumulation of one of more base cations from atmospheric deposition. Some of the southeastern sites with Ultisols showed the expected net retention of $SO_4^{2-}$, but the sites in the Tennessee Valley near Oak Ridge showed surprisingly little ecosystem $SO_4^{2-}$ retention, perhaps due to lower soil $SO_4^{2-}$ adsorption in these soils than in other Ultisols.

## 5103 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 7241, 7242, 7430, 7484, 7494, 7823, 7827, 7828, 7835, 7987, 8472, 9507*

9317 **(BMU—1988-181) Analyses of radioiodine transfer via the air-grass-cow-milk pathway.** Becker, A.; Biesold, H.; Handge, P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1988. 52p. (In German). (GRS-A—1397). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The basis of these studies are the experimental data published in literature on the transport of radioactive iodine by air and the measured results on the concentration of I-131 in the air, on pasture vegetation and in milk in the FRG in the period from 26 April to the end of June 1986 as a consequence of the reactor accident in Chernobyl. The transfer factors 'air/pasture vegetation, pasture vegetation/milk and air/milk' are calculated. In addition to the direct determination of these factors from the measured results, they are also derived from the data for the individual parameters of fallout speed, vegetation density, radioactive half-life of vegetation, transfer factor 'fodder/milk' and fodder quantities of cows. The experimental data taken from literature for the analyses comprise results of studies after nuclear weapons tests, after the emission of radioactive iodine from nuclear power stations and reprocessing plants and also the data obtained in the framework of the Controlled Environmental Radioiodine Test (CERT) programme. According to the results it seems to be useful to conservatively assume a I-131 transition factor of air/ milk of 1500 Bq/l:Bq/3 for an estimation of the potential radiation exposure by the consumption of milk contaminated by I-131, or, to change the transfer factor fodder/milk in the general calculation basis in such a way that it agrees with the values to be expected for that factor in the FRG. For iodine a value of 3x10/sup -3/ Bq/l:Bq/d is adequate.

9318 **(CONF-8810112—8) Determination of low-level radioactivity in environmental samples by gamma spectroscopy at Argonne National Laboratory.** Streets, W.E.; Heinrich, R.R.; Lamoureux, L.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003964/JAW.

From 34. annual conference on bioassay, analytical and environmental radiochemistry; Las Vegas, NV, USA (17 Oct 1988).

We currently have six Ge/Ge(Li) detectors that are being used for gamma counting of environmental samples (three with horizontal geometry, three with vertical geometry). The detectors were calibrated for close-geometry efficiency by counting standards in a set configuration (a height of 6.4 cm in a 4-oz. wide-mouthed Naglene bottle) immediately adjacent to the cryostat face. This configuration was chosen so that the standards would be symmetrical to the centers of both the horizontal and vertical detectors. Two solid standards were prepared by adding a known amount of Standard Reference Material NBL No. 6-A (Pitchblende) and NBL No. 7-A (Monazite Sand) to a blanked soil and mixing. Homogeneity of the standards was checked by counting each standard at each quadrant (on a horizontal detector). The final mixtures showed less than 1% deviation between the high and low quadrant counts. Two liquid secondary standards were prepared from stock solutions of $^{137}Cs$, $^{131}I$, and /sup 110m/Ag, which has been characterized as point sources using several detector efficiency curves. These efficiencies were determined using point source standards from the National Bureau of Standards (NBS) and International Atomic Energy Agency (IAEA). All standards had activity levels that allowed less than 1% counting statistics to be obtained on the major peaks (i.e., those with stronger branching ratio) within two hours. Analysis of the resulting data yield smooth efficiency curves for each of the six detectors. Although the standard compositions varied, solid and liquid, the densities were all $\approx 1.0$ g/cm$^3$. 3 refs.

9319 **(GSF—3/88) Report on measurements of general environmental radioactivity in the Schwandorf area in 1986.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen (GSF), Neuherberg (Germany, F.R.). Abt. fuer Technischen Strahlenschutz; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.)). Jun 1987. 86p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755939/JAW.

The 1986 measuring results clearly display the impact of the Chernobyl reactor accident. Except for ground water and drinking water, there was above all an increase in radioactive cesium 134 and cesium 137 in nearly all samples of foodstuffs. The level of activity depends on the specific foodstuff and is subject to great local and time variations. The renewed rise in the level of Cs-134 and Cs-137 activity in milk measured by other groups in autumn 1986 was also observed in the measurements here reported. Given the long half-life of cesium 137 and in view of the experience gathered after the supraterrestrial nuclear weapons tests at the beginning of the 60s, cesium 134 and cesium 137 from the fallout of the Chernobyl accident will likely continue to account also in the coming years for the greatest share of all artificial radioactive substances in the samples.

9320 **(INIS-mf—11847) Radioactivity monitoring by the official monitoring stations in North-Rhine Westphalia and the Juelich Nuclear Research Centre after the Chernobyl reactor accident.** (Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.)). 1986. 361p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88756100/JAW.

This official report presents a governmental declaration of the prime minister of NRW, Mr. Rau, concerning the reactor accident at Chernobyl, and a joint declaration of ministers of NRW, concerning the impact of the accident on the Land NRW. These statements are completed by six official reports on radioactivity measurements carried out by the official monitoring stations of the Land and by the KFA Juelich. These reports inform about methods, scope, and results of the measuring campaigns accomplished by the Zentralstelie fuer Sicherheitstechnik (ZFS), the public materials testing office (MPA), the Chemisches Untersuchungsamt, the Landesamt fuer Wasser und Abfall, and the KFA Juelich.

9321 **(INIS-mf—11862) Radioecological studies on forest trees. Interim report 1. As of February 1987.** Block, J.; Stelzer, H. (Forstliche Versuchsanstalt Rheinland-Pfalz, Trippstadt (Germany, F.R.)). 1987. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756186/JAW.

Mitteilungen aus der Forstlichen Versuchsanstalt Rheinland-Pfalz.; no. 2/87.

After the reactor accident in Chernobyl, radioecological analyses have been carried out in two forest ecosystems (coniferous and deciduous woods) in Rheinland-Pfalz since the summer of 1986. The activities of the fission products Cs-137, Cs-134 and of the natural nuclide K-40 in different sectors of the ecosystem, and also the absorption and discharge of these radionuclides and their shift within the ecosystem are registered. In addition the time curve of the radionuclide load is followed. The report contains the measured results of the year 1986. The measurements show that the fission products originating from the reactor accident have also been deposited in Rheinland-Pfalz to a considerable extent on the vegetative organs of trees and of forest soil vegetation, and also on the humus cover. They are washed from the leaves or needles by precipitation or reach the ground with needle fall. Relatively high activities, which can mostly be associated with the reactor accident, have been determined in humus covers, spruce needles, mosses and mushrooms. On fundamental differences of agricultural and silvicultural locations, higher accumulation of caesium nuclides in plants on forest soils is probable.

9322 (INIS-mf—11863) **Radioecological measurements of plutonium in the biosphere.** Baechmann, K.; Hartmann, G. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 8 - Anorganische Chemie und Kernchemie). 1985. 20p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756187/JAW.

For the registration of the model soil/plant/air the following measurements were executed: 1) determination of Pu in the soil (soil profiles, resuspension factors). 2) Determination of Pu in the air (seasonal dependence, vertical distribution, Pu on aerosols of different size, deposition of Pu). 3) Determination of Pu in/on plants (seasonal dependences, washing tests with different solvents for determining the fraction of Pu which is bound on plants by adsorption). Some of the measurements were carried out in several successive years in order to register also longer-term changes. Furthermore further elements were determined parallel to Pu in order to find out in how far other elements could serve as models for the behaviour of Pu.

9323 (INIS-XN—141) **Food Protection (Emergency Prohibitions) Order 1988.** (International Atomic Energy Agency, Vienna (Austria)). 7 Jan 1988. 5p. NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704932/JAW.

On 11 January 1988 this Order, made pursuant to the Food and Environment protection Act 1985, came into force. The Order imposes prohibitions on the movement and slaughter for human consumption of sheep in relation to certain designated areas of Scotland. It is a continuation of emergency provisions implemented in response to the Chernobyl accident and replaces the Food Protection (Emergency Prohibitions) (No. 3) Order 1987 and the Food Protection (Emergency Prohibitions)(No. 4) Order 1987.

9324 (KURRI-TR—298, pp 53-58) **Action level for imported food in Japan after the reactor accident at Chernobyl.** Okubo, Takashi. (Institute of Public Health, Tokyo (Japan)). Mar 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780037/JAW. (CONF-8708299—).

From Conference on nuclear environmental safety control; Kumatori, Japan (11 Aug 1987).

The nuclear accident at Chernobyl in Apr. 1986 caused a widespread release of radionuclides to environment. As a result of food movement in international trade, it was necessary to decide action level of radionuclides for food imported in Japan. The action level was derived from the following basic principle: Dose equivalent should be less than one third of 0.5 rem/year for whole body exposure. Assuming that the composition of representative radionuclides (/sup 90/Sr, /sup 134/Cs and /sup 137/Cs) in imported food are equal to those of fallout in Japan and consumption of internal food products reduces total intake of radionuclides to 35 %, action level indicated by sum of /sup 134/Cs and /sup 137/Cs concentrations was estimated to be 370 Bq/kg. From Nov. 1986 to Sep. 1987, it was observed that twenty samples in imported food contained radioactivity exceeding the action level.

9325 (KURRI-TR—300, pp 49-59) **Years of annual ring formation of trees and elements of minute amount.** Katayama, Yukio. (Kyoto Univ. (Japan). Faculty of Agriculture). Feb 1988. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780039/JAW. (CONF-8708300—).

From Intensive seminar on tree rings; Kumatori, Japan (24 Aug 1987).

The structure of the trunks of trees is briefly explained, and the effect of environmental factors such as light, rain, soil, temperature and so on and the effect of environmental pollution are conceivable. The examples of the research on the quantitative determination of the elements of minute amount contained in the annual rings of trees and their use as the living things for environmental pollution index are shown, and the problems are considered. The concentration of manganese contained in annual rings may be used as environmental pollution index. It was pointed out that cadmium accumulated in annual rings had a strong correlation with the decrease of annual ring width. K-40 once taken in annual rings moved radially in connection with physical and physiological actions. The authors have examined the distribution of the elements of minute amount in the trunks, using Japanese cedar, white fir and oak as the specimens. For the quantitative analysis of the elements of minute amount, thermal neutron radioactivation analysis was used, which can analyze many elements simultaneously by nondestructive method. The elements of minute amount in the trunks of Japanese cedar, the difference of the distribution according to the kinds of trees, and the movement of elements within trunks are reported. The application of PIXE method to this analysis is considered. (Kako, I.).

9326 (NAGRA-NTB—87-38) **3-D migration experiment-report 1: site preparation and documentation.** Abelin, H.; Birgersson, L. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1987. 87p. Nagra, CH-5401 Baden, Switzerland.

This report is one of the four reports describing the Stripa 3D experiment where water and tracer flow has been monitored in a specially excavated drift in the Stripa mine. The experiment was performed in a specially excavated drift at the 360 m level in granite. The whole ceiling and upper part of the walls were covered with more than 350 individual plastic sheets where the water flow into the drift could be collected. 11 different tracers were injected at distances between 11 and 50 m from the ceiling of the drift. The flowrate and tracer monitoring was kept up for more than two years. The tracer breakthrough curves and flowrate distributions were used to study the flow paths, velocities, hydraulic conductivities, dispersivities and channeling effects in the rock. The present report describes how the site was prepared and what documentation is available. (author) 1 ref., 39 figs., 9 tabs.

9327 (NAGRA-NTB—87-39) **3-D migration experiment-report 2: instrumentation and tracers.** Abelin, H.; Birgersson, L.; Gidlund, J. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1987. 54p. Nagra, CH-5401 Baden, Switzerland.

This report is one of the four reports describing the Stripa 3D experiment where water and tracer flow has been monitored in a specially excavated drift in the Stripa mine. The experiment was performed in a specially excavated drift at the 360 m level in granite. The whole ceiling and upper part of the walls were covered with more than 350 individual plastic sheets where the water flow into the drift could be collected. 11 different tracers were injected at distances between 11 and 50 m from the ceiling of the drift. The flowrate and tracer monitoring was kept up for more than two years. The tracer breakthrough curves and flowrate distributions were used to study the flow paths, velocities, hydraulic conductivities, dispersivities and channeling effects in the rock. The present report describes the instrumentation developed and used as well as the tracers that were tested and used in the experiment. (author) 2 refs., 25 figs., 6 tabs.

9328 (NEI-DK—107) **Literature study of the behaviour of cesium, strontium and plutonium in the soil-plant ecosystem. Part I: Cesium. Part II: Strontium. Part III: Plutonium.** Nielsen, B.; Strandberg, M. (Risoe National Lab., Roskilde (Denmark)). Jul 1988. 115p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755671/JAW.

Literature on the occurrence of radiocesium (primarily 137CS) in the soil-plant system with emphasis on the influence of treatment on its root uptake, was reviewed. The aim was to study root uptake of radiocesium in order to estimate the applicability of suitable counter measures in cases of contamination of arable land with plutonium, radiostrontium and, in particular, radiocesium. To what extent 136CS is available to, and absorbed by, the plant and how it is distributed and absorbed in the soil is described. The physiological uptake of plutonium from soil through roots to plant parts lying above ground constitutes minor health hazards to population from the ingestion of vegetables. Extensive use of root fruits, might indicate that there is a risk present in areas of high plutonium soil concentration, because plutonium is adsorbed to root mole-

cules, especially if soil and peel are not discarded. Another risk lies in the resuspension of plutonium deposited on the soil surface. As mentioned above, the impact of the leakage of plutonium from the Chernobyl accident was negligible in distant areas. The effects in the vicinity of the reactor, might have been important. In small areas with high levels of plutonium contamination removal of the top soil layer will be effective. Because of the high toxity and long half-life of plutonium, the risk involved merely in isolating such an area will be to high, because the plutonium may be further dispersed. In larger areas, deep ploughing to a depth of 30-40 cm or more, if feasible, is a possibility. Local factors have to be considered, e.g. position of bedrock, groundwater, soil parameters etc. Deep ploughing combined with previous dispersion of clay minerals, lime or humus or a combination, might be a solution, and should be followed by limiting crops to those with roots concentrated in the surface layer and with smallest attainable concentration ratios for plutonium. Cereals might fill this demand. 188 refs. (AB).

9329 **(NILU-TR—2/88) Migration of /sup 137/Cs from air to soil and plants in the Gulsvik area, Norway after the Chernobyl reactor accident.** Pacyna, J.M.; Semb, A.; Christensen, G.C. (Norsk Inst. for Luftforskning, Lillestroem (Norway); Institutt for Energiteknikk, Kjeller (Norway)). (Norsk Inst. for Luftforskning, Lillestroem (Norway)). Feb 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755672/JAW.

The migration of /sup 137/Cs from air to soil and vegetation after the Chernobyl accident has been studied using the concentrations measured in the Gulsvik area in Norway. The major part of the /sup 137/Cs deposition seems to be in the soil. An uptake of /sup 137/Cs from soil to plants through their root system is not a rapid process. Only a few percent of the deposition can be traced in plants. This seems to suggest that as far as /sup 137/Cs is concerned, an effect of the Chernobyl releases is not an acute but a long-term phenomenon. The /sup 137/Cs accumulation in soils is rather high, but doses not result in /sup 137/Cs levels in plants and diet higher than acceptable in Norway.

9330 **(NIRS-RSD—80) Radioactivity survey data in Japan, part 1. Environmental materials.** (National Inst. of Radiological Sciences, Chiba (Japan)). Apr 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756078/JAW.

The report presents data on radioactive substances in environmental materials. Samples collected are rain and dry fallout (monthly for domestic program and monthly for WHO program), airborne dust (quarterly), service water and freshwater (semiyearly for source water, semiyearly for tap water, yearly in fishing season for freshwater), soil (yearly at 1.0 - 5 cm and 5 - 20 cm), sea water (yearly) and sea sediments (yearly). The samples collected are treated appropriately to provide solutions for analysis. Their analysis is carried out as follows. Each sample solution prepared is first neutralized with sodium hydroxide. After sodium carbonate is added, the precipitate of strontium and calcium carbonates is separated and the supernatant solution is used for cesium-137 determination. The carbonates are converted into oxalates, which are then dissolved in nitric acid. Strontium is separated by successive fuming nitric acid separation. The supernatant is acidified and cesium is absorbed on ammonium molybdophosphate added. Stable strontium, calcium and potassium are also determined. After the radiochemical separation, counting of radioactivity is performed using low background beta counters normally for 60 to 90 min. From the results, the concentrations of the nuclides in the original samples are calculated. The contents of the substances in the samples are tabulated. (Nogami, K.).

9331 **(NIRS-RSD—81) Radioactivity survey data in Japan, part 2. Dietary materials.** (National Inst. of Radiological Sciences, Chiba (Japan)). Apr 1988. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756079/JAW.

The report presents data on radioactive substances in dietary materials. Samples collected are total diet (semiyearly), rice (yearly in harvesting season in producing districts and consuming districts), milk (quarterly in February, May, August and November in producing districts for WHO program and semiyearly in February and August in producing districts for domestic program, semiyearly in February and August in consuming districts, semiyearly in April and October for powdered milk), vegetables (yearly in harvesting season in producing districts and yearly in harvesting season in consuming districts), tea (yearly in the first harvesting season), sea fish (yearly in fishing season), freshwater fish (yearly in fishing season), shellfish (yearly in fishing season) and seaweeds (yearly in fishing season). The samples collected are treated appropriately to provide solutions for analysis. Their analysis is carried out as follows. Each sample solution prepared is first neutralized. After sodium carbonate is added, the precipitate of strontium and calcium carbonates is separated and the supernatant solution is used for cesium-137 determination. The carbonates are converted into oxalates, which are then dissolved in nitric acid. Strontium is separated by successive fuming nitric acid separation. The supernatant is acidified and cesium is absorbed on ammonium molybdophosphate added. Stable strontium, calcium and potassium are also determined. The contents of the substances in the samples are tabulated. (Nogami, K.).

9332 **(RISO-M—2741) Users guide for the program TAMDYN. A modelling tool for use on personal computers to simulate environmental transport of contaminants.** Kanyar, B.; Nielsen, S.P. (Risoe National Lab., Roskilde (Denmark)). Mar 1988. 30p. NTIS (US Sales Only), PC A03/MF A01 - Risoe Library, DK-4000 Roskilde. Order Number DE88755677/JAW.

Recent developments in radioecology have stressed the need for providing uncertainties associated with model predictions. Our aim was to get a flexible computer program to estimate these uncertainties even for dynamic processes, and mainly for timedependent solution of compartmental systems. Therefore, we have combined the uncertainty analysis code TAM3 (written by R.H. Gardener, Oak Ridge National Laboratory, USA) and the code of RKF45 for integration of ordinary differential equations by the Runge-Kutta-Fehlberg method. The source program of TAM3 is written in Turbo Pascal for PC-computers and so is the present extension for dynamic systems. The structure of the compartmental system (number of compartments, non-zero transfer coefficients etc.) can be defined from the input data. The extension to dynamic systems includes an option to modify the values of the state variables and nontransfer parameters during the solution of the differential equations. The modifications are given in the input data and are useful for the simulation of contaminations, harvesting etc.

## 5105 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 7493, 7987, 8798, 8799, 8839, 9535*

## 5106 Regulations

*REFER ALSO TO CITATION(S) 9424*

9333 **(PB—88-246806/XAB) Permit-writers guidance manual for the location of hazardous-waste land treatment, storage, and disposal facilities. Phase 2. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Jun 1986. 17p. (SAB/EEC—86/016). NTIS, PC A03/MF A01.

See also PB—86-125580.

The guidance was prepared by the Office of Solid Waste (OSW) in response to a requirement in Section 3004 (o) (7) of RCRA, which requires the Agency to publish guidance criteria for identifying areas of vulnerable hydrogeology and to promulgate regulations specifying criteria for the acceptable location of new and existing RCRA facilities.

9334 **(PB—89-115695/XAB) Permit applicants' guide manual for hazardous-waste land treatment, storage, and disposal facilities. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1984. 656p. (EPA—530-SW/84/004). NTIS, PC A99/MF A01.

Also available from Supt. of Docs. See also PB—87-151064. Portions of this document are not fully legible.

The manual explains the EPA permitting process, the facility standards, and the application information requirements. It describes the level of detail needed in a permit application to show how the facility design complies with specific standards. Useful references to other EPA manuals and to the professional engineering and hydrogeologic literature are provided. The manual is written for persons who must file applications with the EPA for Federal permits to operate facilities that treat, store, or dispose of hazardous waste in surface impoundments, waste piles, land-treatment units, and landfills. Authorized States that administer their own programs may have different permitting procedures not covered in the manual.

9335 **(PB—89-117378/XAB) Superfund record of decision (EPA Region 1): Keefe environmental site, Epping, New Hampshire, March 1988 (second remedial action). Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). 21 Mar 1988. 164p. (EPA/ROD/R—01-88/024). NTIS, PC A08/MF A01.

See also PB—85-213601.

This report is a record of decision. It described the situation of industrial-wastes disposal pollution (mainly water pollution) and pollution control at Keefe Environmental Services (KES) site. The report proposed the selected remedial action for the site and estimated the cost for the remedial action.

9336 **(PB—89-117402/XAB) Superfund record of decision (EPA Region 3): L. A. Clarke and Son, Spotsylvania County, Virginia, March 1988. First remedial action.** (Environmental Protection Agency, Washington, DC (USA)). 31 Mar 1988. 83p. (EPA/ROD/R—03-88/040). NTIS, PC A05/MF A01.

The 40-acre L.A. Clarke site, located in Spotsylvania County, Virginia, began wood-preserving operations in June 1937, which have continued to date. During the past 50 years, creosote contaminated soil and sediments resulted from facility-operations spills, waste streams entering the drainage ditches, and onsite disposal. Historical aerial photography indicates that from at least 1953 through 1974 waste water was disposed into two concrete-lined pits. Overflow from the concrete pits was stored in an earthen pit. Excess water was discharged to drainage ditches and sprayed on the ground around the storage yard to control dust. In 1975, L.A. Clarke & Son, Inc. was issued a National Pollution Discharge Elimination System (NPDES) permit for outfalls from two onsite drainage ditches which is still in effect. Phenol is the only toxic contaminant regulated by the permit. In 1980, L.A. Clarke & Son, Inc. was classified under RCRA as a treater of hazardous waste. As part of a State-mandated remedial action in 1982, approximately 1,400 cu yd of soil was excavated from the processing area.

9337 **(PB—89-117428/XAB) Superfund record of decision (EPA Region 2): Love Canal, Niagara Falls, New York, October 1987. Second remedial action.** (Environmental Protection Agency, Washington, DC (USA)). 26 Oct 1987. 79p. (EPA/ROD/R—02-88/055). NTIS, PC A05/MF A01.

See also PB—85-232080.

The Love Canal site is located in the southeast corner of the city of Niagara Falls and is approximately one-quarter mile north of the Niagara River. The canal was one of two initial excavations designed to provide inexpensive hydroelectric power for industrial development around the turn of the 20th century. Hooker Chemicals and Plastics Corporation (Hooker), now Occidental Chemical Corporation, disposed of over 21,000 tons of chemical wastes, including dioxin-tainted trichlorophenols, into Love Canal between 1942 and 1953. In the mid to late 1970s, continued periods of high precipitation contributed to water accumulation in the disposal area causing chemically-contaminated leachate to be carried to the surface and into contact with residential-basement foundations. Also, dioxin and other contaminants migrated from Love Canal to the sewers which have outfalls to nearby creeks. The remedial program at Love Canal has been extensive and has occurred in two phases. Approximately 30,400 cu yd - 40,900 cu yd of creek and sewer sediments are contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin, commonly referred to as dioxin.

9338 **(PB—89-117444/XAB) Superfund record of decision (EPA Region 5): Lasalle Electrical Utilities Site, Lasalle, Illinois, March 1988.** (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). 30 Mar 1988. 79p. (EPA/ROD/R—05-88/061). NTIS, PC A05/MF A01.

See also PB—87-189379.

The LaSalle Electrical Utilities (LEU), a former manufacturer of electrical equipment, began operating prior to World War II. Between the late 1940s and 1978, PCBs were utilized in the production of capacitors. Soil sampling conducted by the Illinois Environmental Protection Agency (IEPA) in December 1980 documented onsite PCB contamination. Continued soil sampling revealed offsite contamination in March and May 1981. The IEPA ordered the company to cease operations in May 1981. The U.S. EPA conducted Immediate Removal Actions that involved fencing the LEU property and capping a portion of the heavily contaminated onsite property; capping contaminated offsite property to the south of the site; and staging, sampling, and packaging PCB waste material for future disposal. The first operable unit ROD, signed September 19, 1986, addressed offsite soil contamination. The second remedial action operable unit addresses PCB and VOC contamination in soil, sediments, building structures, and ground water. The selected remedial action for the site is proposed in the report. The estimated present-worth cost for the remedial action is $34,495,180.

# 52 ENVIRONMENTAL SCIENCES, AQUATIC

*REFER ALSO TO CITATION(S) 9142*

## 5201 Basic Studies

*REFER ALSO TO CITATION(S) 7295, 7296, 7297, 7362, 8800, 8801, 9363, 9631*

9339 **(CWS—8803) Key areas for birds in coastal regions of the Canadian Beaufort Sea.** Alexander, S.A.; Barry, T.W.; Dickson, D.L.; Prus, H.D.; Smyth, K.E. (Canadian Wildlife Service, Edmonton, Alberta). 1988. 151p. (MICROLOG—88-03342). Canadian Wildlife Service, 175 Woodward Dr., Ottawa, Ont., Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this project was to develop a series of maps which identify the key areas for birds along the Beaufort Sea coast. This resulting atlas was primarily designed to enable quick responses to questions pertaining to bird distributions that may arise in the event of an oil spill in the Beaufort Sea region. Seasonal differences in the requirements of birds were considered through separate evaluations in each of four time periods: spring migration (May to mid-June), nesting (June to mid-July), molting/broodrearing (mid-July to mid-August), and fall migration (mid-August to late September). The evaluations are presented in a series of 10 maps as color-coded delineations of regions of high, moderate, variable and low avian use. For each region in each time period there is a description of the major aspects of avian use (which may include comments on local population estimates, behavior, year to year variation in numbers, and local movements of birds), and a listing of some of the data used in the evaluations. A general discussion on the limitations of the data used is presented in the introductory sections as an aid to the interpretation of information contained in the report. The region covered by this atlas extends east along the Beaufort Sea coastline from the Alaska-Yukon border to the Baillie Islands off the tip of the Bathurst Peninsula. A section on spring migration through open water leads covers also Amundsen Gulf and Banks Island. Emphasis was placed on the nearshore waters of the Beaufort Sea and the land that is below the storm tide line. However, some information on birds using areas above the storm tide line was also reviewed and summarized. 68 refs., 10 figs.

**9340 (EC/W—8801) Water quality and biological survey of stream and lake habitats in the vicinity of King Point, Yukon-Beaufort Sea coast.** Davidge, D.; Mackenzie-Grieve, G. (Environment Canada, Whitehorse, Yukon). 1988. 66p. (MICROLOG—88-04784). Environment Canada, Document, Text and Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A baseline inventory survey of water chemistry, sediment and biological conditions was conducted at several stream and lake locations near King Point, along Yukon's Beaufort Sea coastline, in August of 1985. This investigation was conducted to provide additional information on freshwater habitats in the vicinty of proposed major developments in support of the Beaufort Sea offshore oil and gas exploration and development. Stream and lake water quality were generally of a pristine nature with most chemical parameters present being well below the recommended criteria for drinking water. The exceptions were elevated Fe and Hg detected in some stream and lake samples. Nutrient levels found in the lakes surveyed indicated they were characteristic of ultra-oligotrophic conditions. Benthic invertebrate populations were not comparable due to different sampling methods; however, the results obtained provide some representation of benthic invertebrates present in coastal tundra lakes. 14 refs., 3 figs., 13 tabs.

**9341 (GSF—9/88) Tracer techniques for determination of groundwater flow parameters.** Drost, W.; Klotz, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Hydrologie). May 1988. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756182/JAW.

The most common one-borehole and multiple borehole methods using tracers for the direct determination of the groundwater flow parameters (velocity of flow, flow direction) and for the indirect determination of characteristic quantities of the aquifer (effective porosity, dispersivity, transmissivity) are presented methodically and their value is documented by practical examples. Especially, the properties of and measuring technique with suitable tracers are considered (e.g. T, Na-24, Cr-51, Co-58, Co-60, Br-82, Tc-99, I-125, I-131, Au-198).

**9342 (PB—88-249057/XAB) Behavioral responses of gray whales to industrial noise: feeding observations and predictive modeling.** Malme, C.I.; Wuersig, B.; Bird, J.E.; Tyack, P. (BBN Labs., Inc., Cambridge, MA (USA)). Aug 1986. 206p. NTIS, PC A25.

An investigation was made of the potential effects of underwater noise from petroleum-industry activities on feeding gray whales. The investigation consisted of two components, a field study and an acoustic model study. The field study was performed near Southeast Cape, St. Lawrence Island in August, 1985, using a 100 cu. in. air gun source and playback of drillship noise. Sound-source levels and acoustic-propagation losses were measured to permit estimation of sound exposure levels at whale-sighting positions. For the air-gun source there was a 0.5 probability that the whales would stop feeding and move away from the area when the average pulse levels reached 173 dB.

**9343 (PNL-SA—16350) Biotic and abiotic controls in river and stream communities.** Cushing, C.E.; Power, M.E.; Harper, P.; Hauer, F.R.; Matthews, W.J.; Moyle, P.B.; Stazner, B.; Stout, R.J.; Wais de Badgen, I.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 63p. (CONF-8704334—1). NTIS, PC A04/MF A01 - OSTI. Order Number DE89002359/JAW.

From NSF workshop; Flathead Lake, MT, USA (24 Apr 1987).

Without attempting to be comprehensive in our review, we discussed limits and limitations of our knowledge in these areas. We also suggested types of data and technological development that would advance our understanding. While we appreciate the value and need for empirical and comparative information, we advocate search for key mechanisms underlying community interactions as the crucial step toward developing general predictions of responses to environmental change. These mechanisms are likely to be complex, and elucidation of interacting bilateral, or multilateral, biotic and abiotic controls will progress only with the continuing synthesis of community- and ecosystem-level approaches in lotic ecology. 189 refs.

## 5202 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7211, 7294, 7342, 7346, 7348, 7552, 7885, 8025, 8027, 8479, 9200, 9201, 9260, 9292, 9297, 9298, 9301, 9312, 9313, 9314, 9315, 9515, 9543, 9573, 9584*

**9344 (AD-A—197118/3/XAB) Field-verification program (aquatic disposal): comparison of field and laboratory bioaccumulation of organic and inorganic contaminants from Black Rock Harbor dredged material. Final report.** Lake, J.L.; Galloway, W.; Hoffman, G.; Nelson, W.; Scott, K.J. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). May 1988. 201p. (WES-TR-D—87-6). NTIS, PC A10/MF A01.

The utility of laboratory tests for predicting bioaccumulation of contaminants in the field was evaluated by comparing the identities, relative abundances, and quantities of organic and inorganic contaminants accumulated by organisms exposed to dredged material in both laboratory and field studies. The organisms used were Mytilus edulis (a filter-feeding bivalve) and Nephtys incisa (a benthic polychaete). These organisms were exposed in the laboratory and in the field to a contaminated dredged material from Black Rock Harbor (BRH), Connecticut. Both organisms had positive and negative attributes for these exposure studies. Mytilus edulis appeared to reach steady-state in laboratory-exposure studies. However, the determination of field-exposure concentrations was precluded due to limitations on obtaining an integrated water sample during the exposure period in the field. Nephtys incisa did not appear to reach steady-state in laboratory studies and, although field-exposure data (sediment concentrations) were obtained, the exposure zone for these organisms could not be determined. Estimates of field exposures were made using laboratory-derived exposure-residue relationships and residues from field-exposed organisms. These field-exposure estimates were compared with those estimated using exposure data from the field. A comparison of these estimates showed the same general trends in the exposure-residue relationships from the laboratory and the field and further supports the laboratory predictive approach.

**9345 (AD-A—197309/8/XAB) Installation-restoration program. Phase 2. Confirmation/quantification. Stage 1 for Air Force Plant 59, Johnson City, New York. Final report, 15 March 1984-15 March 1988.** (Hart (Fred C.) Associates, Inc., New York (USA)). Mar 1988. 123p. NTIS, PC A06/MF A01.

A Phase II, Stage I site investigation was performed at the USAF Plant No. 59 (AFP 59) in Johnson City, New York. AFP 59 is located in an industrial area adjacent to the Susquehanna River. The site overlies the Clinton Street-Ballpark Valley aquifer which consists of glacial valley fill sediments of clay, silt, sand and gravel. This aquifer is a major source of ground water in the area and has been designated a sole source aquifer. As part of the field investigation, a total of three shallow monitoring wells were installed to depths of 26-29 feet. Three shallow test borings (10 feet) were also drilled near the plating operations. Fifteen (15) subsurface soil samples plus QA/QC samples were submitted for laboratory analysis. The solid samples showed trace levels of EP Toxicity metals which were below EP Toxicity maximum contaminant levels. Groundwater samples were collected from the 3 wells installed during the investigation and from one production well at the site. Two metals (cadmium and lead) and two organics (trichloroethane and trans-1,2-dichloroethene) were detected in samples at levels equal to or in excess of current relevant criteria, standards, or guidance values. Analytical results indicate some correlation with chemicals reportedly stored and used in industrial processes at AFP 59 in the past. The distribution of similar contaminants in ground-water and soil were inconsistent throughout the site. A major receptor near AFP 59 is the impact this contamination may have on municipal water-supply wells within 1000 feet southwest of the site.

9346 **(AD-A—197463/3/XAB) Alternate methods for disposal of nitrocellulose fines. Final technical report, August 1984-June 1985.** Brown, J.A.; Skovronek, H.S. (Brown (John A.) Associates, Berkeley Heights, NJ (USA)). 22 Jul 1985. 54p. NTIS, PC A04/MF A01.

A review of commercial waste-water treatment processes has shown that there are no directly comparable industrial problems. Other industries with problems of colloidal solids, such as phosphate mining, pigments manufacture, etc., use combinations of conventional technologies (coagulation, sedimentation, filtration) or have ponds where evaporation plays an important role. There is only one U.S. nitrocellulose manufacturer, and that facility discharges directly to the river just as the Radford Army Ammunition Plant does and is in compliance just as RAAP is. Cellulose fines are not as small as NC fines and tend to incorporate into paper products when water is recycled; and, being ubiquitous in nature, are not considered pollutants anyway.

9347 **(AD-A—197481/5/XAB) Potentially toxic emissions produced by plastic media. Final report, October-December 1987.** Radonich, B. (Engineering Management Concepts, Camarillo, CA (USA)). Apr 1988. 57p. NTIS, PC A04/MF A01.

This engineering analysis was performed to evaluate the potential for releases of hazardous gases and concentrations of toxic metals in new plastic media. Samples from three manufacturers were tested for releases of phenol, cyanide, and formaldehyde, and environmental protection (EP) toxicity metals. Only formaldehyde releases from formaldehyde resins exceeded threshold limit values (TLV) limits under high temperatures (200C). It is recommended that testing for formaldehyde be a regular part of health reviews for plastic-media blasting operations.

9348 **(AD-A—197540/8/XAB) Waste-water characterization and hazardous-waste survey, Reese Air Force Base, Texas. Final report, 21-30 September 1987.** Binovi, R.D.; Slavich, F.E. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Apr 1988. 112p. (USAFOEHL—88-067EQ0165DSC). NTIS, PC A06/MF A01.

The USAFOEHL conducted a waste-water and hazardous-waste characterization survey from 21 to 30 September 1987 at Reese AFB, Lubbock County, Texas. The scope of the survey included the characterization of the waste-water exiting the main oil-water separator, entering and exiting the sewage treatment plant into the sewage lake, in the industrial lake, and from 19 points in the sanitary and storm sewer system. Hazardous-waste-management surveys were conducted at 28 locations generating or accumulating potentially hazardous waste. Priority pollutants were found in the sanitary and storm system, in the surface impoundments, and in a septic system. Apparently all industrial discharges containing hazardous constituents had not been eliminated from the sanitary and stormwater systems. Priority pollutants found in the influent of the sewage treatment plant and in the sewage lake were not significant in nature or concentration. Pretreatment and removal of hazardous constituents from the waste water will be required if the hazardous material cannot be prevented from entering the wastewater stream.

9349 **(AD-A—197562/2/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Reese Air Force Base, Lubbock, Texas. Volume 2. Appendices. Final report, May 1986-April 1988.** (Ecology and Environment, Inc., Lancaster, NY (USA). Buffalo Corporate Center). Apr 1988. 946p. NTIS, PC A99/MF E04.

See also Volume 1, AD-A197 892.

The overall objective of the Phase II investigation is to define the magnitude, extent, direction and rate of movement of identified contaminants. A series of staged field investigations may be required to meet this objective. The contractor shall recommend any additional investigations required beyond this stage (Stage 1), including an estimate of costs. The purpose of this task is to undertake a field investigation at Reese AFB TX: (1) to determine the presence or absence of contamination within the specified areas of investigation; (2) if possible, determine the magnitude of contamination and the potential for migration of those contaminants in the various environmental media; and (3) identify significant public health and environmental hazards of migrating pollutants based on State or Federal standards for those contaminants.

9350 **(AD-A—197799/0/XAB) Residual-explosives criteria for treatment of Area P soil, Louisiana Army Ammunition Plant. Final report, February 1987-January 1988.** Small, M.J. (Army Biomedical Research and Development Lab., Fort Detrick, MD (USA)). 11 Mar 1988. 62p. (USABRDL-TR—8807). NTIS, PC A04/MF A01.

From about 1950 to 1980, the Louisiana Army Ammunition Plant, near Shreveport, discharged waste water from its explosives load, assembly, and pack activities into a complex of leaching pits known as Area P. The ground water under Area P was found to contain the explosives TNT, RDX, and HMX as well as related compounds. The Army plans to incinerate soil that has been excavated from this area to a limited depth. An assessment of this plan from a health-effects viewpoint was requested, details of which are documented in this report. Three situations were addressed, those of potable ground water, safety of surface water for aquatic life, and future construction activities. State regulations require the uppermost aquifer to be addressed as a potential water supply; at Area P, the uppermost aquifer is the alluvial aquifer. The assessment concluded that current levels of explosive contamination in groundwater probably exceed acceptable levels of drinking-water quality.

9351 **(AD-A—198107/5/XAB) Field verification program (aquatic disposal). A field and laboratory study using adenylate energy charge as an indicator of stress in Mytilus edulis and Nephtys incisa treated with dredged material. Final report.** Zaroogian, G.E.; Rogerson, P.F.; Hoffman, G.; Johnson, M.; Johns, D.M. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). Jun 1988. 168p. NTIS, PC A08/MF A01.

A study was conducted to test the applicability of adenylate energy charge (AEC) and adenine nucleotide pool concentrations as measures of biological response in the blue mussel, Mytilus edulis, and the marine polychaete, Nephtys incisa, after exposure in the laboratory an field to contaminated dredged material from Black Rock Harbor (BRH), Bridgeport, Conn. A second objective was to include field verification of laboratory results, and a third objective was to investigate residue-effect relationships between tissue concentrations of BRH contaminants and AEC and adenine nucleotide pool concentrations. Tissue residue concentrations, particularly of persistent compounds such as polychlorinated biphenyls, were found to be closely related to exposure concentration. The biological responses evaluated in this report included the adenine nucleotide measures of adenosine triphosphate, adenosine diphosphate, adenosine monophosphate, adenylate pool, and AEC. Adenine nucleotides and AEC are important in energy transformation and in regulation of metabolic processes. Responses in adenine nucleotide pools correlate with tissue concentrations of BRH contaminants in exposed organisms. Measurement of the adenine nucleotide concentrations may help to characterize the energy costs incurred by organisms under stressful conditions.

9352 **(AD-A—198542/3/XAB) Improvement of operations and maintenance techniques research program: an evaluation of the standard elutriate test as an estimator of contaminant release at the point of dredging. Final report.** Ludwig, D.D.; Sherrad, J.H.; Amende, R.A. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Aug 1988. 54p. NTIS, PC A04/MF A01.

While release of contaminants during dredged material disposal operations has long been the subject of environmental concern for some projects, the potential release of pollutants during the dredging process has recently come under the scrutiny of Federal and State regulatory agencies. Maintenance of shipping channels may require the removal of sediments suspected to contain high concentrations of contaminants. During any dredging operation, sediments become resuspended to varying degrees according to sediment type, hydrologic conditions, type of dredging equipment used, and operational procedures employed. Contaminants may be released in soluble form directly to the water column, or they may remain adsorbed to the fine resuspended sediment particles. The primary mode of environmental impact is from the soluble fraction,

since dissolved forms of pollutants are more available for aquatic biota uptake than those that remain adsorbed to sediment particles.

9353 **(AD-A—198861/7/XAB) Installation-restoration program, Stage 3 McClellan Air Force Base. Final report, 1 April-15 July 1988.** (Radian Corp., Sacramento, CA (USA)). Sep 1988. 315p. NTIS, PC A14/MF A01.

This Semiannual Informal Technical Report summarizes the interpretive results for analytical and hydrologic data obtained during ground-water sampling and analysis at McClellan AFB from August 1979 through the First Quarter 1988. The data are used to evaluate the occurrence and migration of ground-water contaminants, to assess the variability in the sampling and analytical processes, to identify any hydrologic and analytical trends developing with time, and to evaluate the effectiveness of the Area D extraction system. The occurrence and migration of trichloroethene(TCE) in the ground water was evaluated. Several factors controlling the direction of contaminant flow and the rate of contaminant migration are discussed. These include the effects of pumping by active base production wells and the Area D extraction wells.

9354 **(AD-A—199227/0/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 2. Volume 1. Luke Air Force Base, Arizona. Final report, September 1986-June 1988.** Hill, G.; Jones, D.; Dunn, A. (Weston (Roy F.), Inc., West Chester, PA (USA)). 15 Jun 1988. 245p. NTIS, PC A11/MF A01.

See also Volume 3, AD-A199 228.

An Installation-Restoration Program (IRP) Phase II Stage 2 study was performed at Luke AFB, AZ. Five sites (plus the base production wells) were investigated: a canal that receives runoff which has bypassed an oil/water separator (the O/W Separator Canal); a petroleum, oil, and lubricants disposal area; a former fire training area a site that contains both current and former fire training areas and a series of lagoons that receive effluent from the base Sewage Treatment Plant. The scope of the investigation included soil-gas surveys at three sites, a geophysical survey at all sites, monitor well installation and groundwater sampling at all sites including the base production wells, and surface water and sediment sampling at two sites. Analytes included volatile organic compounds, base/neutral-acid extractable compounds, pesticides, PCBs, heavy metals, and other indicator and site-specific parameters.

9355 **(AD-A—199228/8/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 2. Volume 3. Luke Air Force Base, Arizona. Final report, September 1986-June 1988.** (Weston (Roy F.), Inc., West Chester, PA (USA)). Jun 1988. 790p. NTIS, PC A99/MF E04.

See also Volume 1, AD-A199 227, and Volume 4, AD-A199 229.

Partial Contents include: Olatile Organic Compounds; Beta Naphthylamine; Pesticide/PCB; Oil and Grease, TOC, Nitrate/Nitrite, and TKN; Radiological Results; Dibromochloropropane; and Metals Results.

9356 **(AD-A—199484/7/XAB) Installation-Restoration Program. Phase 2. Confirmation quantification. Stage 2 for MacDill Air Force Base, Florida. Volume 1. Final report, June 1986-July 1988.** (Engineering-Science, Inc., Atlanta, GA (USA)). 22 Jul 1988. 794p. NTIS, PC A99/MF E04.

See also Volume 2, AD-A199 485.

An Installation-Restoration Program (IRP) Phase II, Stage 2 investigation was conducted at MacDill AFB and Avon Park AFR, Florida, to confirm the presence or absence of contamination at twelve sites. Eight of the twelve sites were previously investigated under Phase II, Stage I efforts. Four sites had not previously been investigated under Phase II efforts. A field program was conducted, consisting of geophysical surveys, the drilling and installation of 28 monitoring wells, an aquifer pumping test in the surficial aquifer, and the collection and analysis of ground water, surface water, and sediment samples. At MacDill AFB, no significant contaminants were found at two of the sites. These sites were recommended for no further action. At three other sites no significant contamination was found but other evidence suggested that additional study should be considered before specific action at these sites is recommended. Significant contamination was found at three sites and these sites were recommended for additional investigation. One site at MacDill AFB was recommended for remedial action. At Avon Park AFR, all three sites showed no significant contamination and were recommended for no further action.

9357 **(AD-A—199485/4/XAB) Installation-Restoration Program. Phase 2. Confirmation quantification. Stage 2 for MacDill Air Force Base, Florida. Volume 2. Final report, June 1986-July 1988.** (Engineering-Science, Inc., Atlanta, GA (USA)). 22 Jul 1988. 658p. NTIS, PC A99/MF A01.

See also Volume 1, AD-A199 484.

An Installation-Restoration Program (IRP) Phase II, Stage 2 investigation was conducted at MacDill AFB and Avon Park AFR, Florida, to confirm the presence or absence of contamination at twelve sites. Eight of the twelve sites were previously investigated under Phase II, Stage 1 efforts. Four sites had not previously been investigated under Phase II efforts. A field program was conducted, consisting of geophysical surveys, the drilling and installation of 28 monitoring wells, an aquifer pumping test in the surficial aquifer, and the collection and analysis of ground water, surface water, and sediment samples. At MacDill AFB, no significant contaminants were found at two of the sites. These sites were recommended for no further action. At three other sites no significant contamination was found but other evidence suggested that additional study should be considered before specific action at these sites is recommended. Significant contamination was found at three sites and these sites were recommended for additional investigation. One site at MacDill AFB was recommended for remedial action. At Avon Park AFR, all three sites showed no significant contamination and were recommended for no further action.

9358 **(CONF-8810133—3) Second-derivative ultraviolet absorption monitoring of aromatic contaminants in groundwaters.** Haas, J.W. III; Lee, E.Y.; Thomas, C.L.; Gammage, R.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004188/JAW.

From 1. international symposium on field screening methods for hazardous waste site investigations; Las Vegas, NV, USA (11 Oct 1988).

A portable spectrometer for second-derivative ultraviolet absorption spectrometry (DUVAS) has been evaluated for the screening of aromatic contaminants in groundwaters. Benzene, its derivatives, and polycyclic aromatic hydrocarbons were found to be amenable to analysis by this technique at concentrations down to 1 ug/mL. Based on these encouraging results, construction of a rugged, underwater fiber optic probe for direct, down-well pollutant monitoring using DUVAS has begun. A prototype of the probe was used successfully to obtain spectra in the laboratory. When the new probe is completed it will be used to monitor benzene in a groundwater well at a hazardous waste site. 5 figs.

9359 **(DOE/ER/60508—2) A study of the physical-chemical mechanisms and variables which affect the transport of inorganic and organic heterogeneous systems: Progress report for period December 15, 1987--December 14, 1988.** Anderson, M.A.; Tejedor-Tejedor, M.I.; Zeltner, W.A. (Wisconsin Univ., Madison (USA)). Aug 1988. Contract FG02-87ER60508. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004329/JAW.

Our primary goal in this research is to investigate the reaction mechanisms and important non-biological variables which affect the partitioning of microcontaminants in aqueous systems between the bulk solution and solid-phase adsorbents. The primary technique used for this work is cylindrical internal reflection-Fourier transform infrared (CIR-FTIR) spectroscopy, in conjunction with wet chemical adsorption studies, and electrophoretic mobility and acoustophoresis measurements. We have had limited success in attempting to develop CIR-FTIR spectroscopy into a quantitative technique for the study of suspensions. Difficulties are related primarily to the nature of the arrangement of suspension particles around the CIR crystal and the design of the CIR optics. Because of the importance of particle-particle interactions and agglomeration in these more concentrated suspensions, we are using a new technique, acoustophoresis, to aid in evaluating the interparticle

forces which determine the arrangement of these particles. These interparticle forces affect particle-particle organization not only in the CIR cell but also in the environment. This report discusses our initial efforts to utilize acoustophoresis instrumentation. 7 refs., 4 figs.

**9360 (EPS—1988) Wastewater Technology Centre annual report, fiscal year 1986/87.** (Environnement Canada, Ottawa, Ontario. Conservation et Protection). [1988]. 106p. (CE—02021). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C.

The role of the Wastewater Technology Centre, a Canadian federal facility located in Ontario, is to initate and implement environmental control technology development programs which address the priority concerns of toxic chemicals, energy related activities, acid rain, northern development, and various Canadian inland waters. Facilities consist of a wide variety of wastewater and sludge treatment pilot plants, offices, laboratories, and mobile units. The Centre has support services supplying laboratory and computer help, and three research sections. The Biological Processes Section's major areas of research are anaerobic treatment processes, automated process control of activated sludge systems, and the fate of toxic trace organics in biological treatment systems. The major emphasis for the Physical/Chemical Processes Section is on projects involving the treatment of effluents from gold mining operations and from in-situ heavy oil/bitumen recovery facilities. The major areas of Residue Management Section research are the demonstration of liquid fuel production from sewage sludge; development of control strategies for sludge dewatering; assessment of solidification as a hazardous waste management control option; and assessment of fate and degradation of toxic organics in sludge applied to land. This report describes the individual research projects, their objectives, relevance, work plans, and current status. A list of papers, reports, and presentations is included. 46 refs.

**9361 (EPS—1988) Wastewater Technology Centre quarterly report, April-June, 1988.** (Environnement Canada, Ottawa, Ontario. Conservation et Protection). [1988]. 75p. (CE—02022). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C.

The Wastewater Technology Centre is a Canadian federal facility in Ontario that conducts research and development in waste water management and characterization, with priority concerns in the areas of toxic chemicals, energy related activities, acid rain, northern development, and Canadian inland waters. This report describes the objectives, relevance, work plans, and current status of the Centre's research projects conducted in the Biological Processes, Residue Management, and Physical/Chemical Processes Sections.

**9362 (Juel-Spez—440) Methods for the ecotoxicological evaluation of chemicals. Vol. 10. Aquatic systems 3. Report 1979-1986.** Verfondern, M.; Scheele, B. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie). Apr 1988. 282p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755981/JAW.

The five research projects presented in this report, are dealing with the effect of chemicals in aquatic systems. In the first three papers, the bioaccumulation, the elimination, and the sublethal effect of chemicals on different aquatic organisms (carps, zebra fish, algae) are examined and the qualification of these chosen organisms for 'mono species tests' is discussed. The fourth paper describes a test system using the periphyton development in time. In the fifth project, the possible use of artificial ponds as model ecosystems is checked. For the evaluation of ecotoxicological effects of chemicals in 'multi species tests', such systems promise to close the gap between 'mono species tests' and the natural environment.

**9363 (OE—1988) Technology transfer conference, 1987. Part B. Water quality research.** (Ontario Ministry of the Environment, Toronto (Canada)). 1988. 439p. (CONF-8711267—; MICROLOG—88-04889). Ontario Ministry of the Environment, Communications Branch, 135 St. Clair Ave., West, 6th Floor, Toronto, Ont., Canada M4V 1P5; $3.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

From Technology transfer conference; Toronto, Canada (30 Nov 1987).

A conference was held in Ontario to report and publicize the progress made on projects funded by the provincial environment ministry in the area of water quality research. Papers were presented on monitoring environmental contaminants, behavior of contaminants in surface waters, water quality assessment, removal of contaminants from drinking water, toxicity studies, sewage treatment, and water treatment processes. Separate abstracts have been prepared for three papers from this conference.

**9364 (PB—88-247754/XAB) Personal monitors for inorganic gases. Final report, 28 September 1978-31 August 1979.** West, P.W. (Louisiana State Univ., Baton Rouge (USA)). 1979. 27p. NTIS, PC A03/MF A01.

Successful passive sampling techniques were developed for ammonia and hydrogen-cyanide. For ammonia the collection of the sample required permeation through a silicone membrane into boric acid. Spectrophotometric determination of the ammonia was carried out using Nessler's reagent or potentiometrical means with an ion-selective electrode. Linearity was demonstrated using the monitor over concentration ranges of less than 10 to over 160 parts per million. The ammonia monitor was relatively free from interference by amines and could be used in a badge-type monitor, as it was very light in weight and compact. The hydrogen-cyanide monitor functioned by permeation through a silicone membrane. The permeated gas was stabilized in sodium hydroxide and determined by means of a standard pyridine/barbituric acid colorimetric method. A detection limit of 10 parts per billion for an 8-hour exposure was obtained. Difficulties were encountered in developing a sampler for hydrogen sulfide.

**9365 (PB—88-248406/XAB) Control of indoor air contaminants. Progress report.** Ayer, H.E. (Cincinnati Univ., OH (USA)). 1988. 20p. NTIS, PC A03/MF A01.

Efforts were made to determine the probability of air contaminants within 1 meter reaching the nose from either a point-source thermal generation of an aerosol or from generations of vapor by evaporation. The study also attempted to define the objective criteria for evaluation of mixing (K) factors between 1 and 10 meters of individual contaminant spaces or in an entire room. Small, thermally generated plumes were able to move with little dilution through spaces of 1 meter and more. Concentrations of acrolein and formaldehyde in side-stream cigarette smoke were tens to hundreds of times the acceptable limits. Between one and two thirds of these concentrations were associated with the particulate phase of the smoke, suggesting that aldehydes may be deposited in the respiratory system rather than absorbed in the nose and trachea, perhaps providing a pathway for bronchial cancer. Concentrations of irritants in contaminant streams sufficient to cause eye or nose/throat irritation may be measured by sampling close enough to the source to trap the entire contaminant stream.

**9366 (PB—88-248752/XAB) Selection criteria for mathematical models used in exposure assessments: ground-water models.** Bond, F.; Hwang, S. (ICF Northwest, Richland, WA (USA)). May 1988. 242p. NTIS, PC A11/MF A01.

See also PB—88-139928.

Prior to the issuance of the Guidelines for Estimating Exposures in 1986, the U.S. Environmental Protection Agency (EPA) published proposed guidelines in the Federal Register for public review and comment. The purpose of the guidelines is to provide a general approach and framework for carrying out human and non-human exposure assessments for specific pollutants. The purpose of the document is to present criteria that provide a means for selecting the most-appropriate mathematical model(s) for conducting an

exposure assessment related to ground-water contamination. General guidelines and principles for model-selection criteria are presented followed by a step-by-step approach to identifying the appropriate model(s) for use in a specific application. Two site-specific example problems are provided to demonstrate the procedure for selecting the appropriate mathematical model for a particular application.

9367 **(PB—88-249537/XAB) Dow Chemical waste-water characterization study: Tittabawassee River sediments and native fish. Final report.** Amendola, G.A.; Barna, D.R. (Environmental Protection Agency, Westlake, OH (USA). Environmental Services Div.). Jul 1986. 132p. (EPA—950/4-88/003). NTIS, PC A07/MF A01.

This report presents the results of EPA's study of dioxins and other toxic pollutants at the Dow Chemical-Midland Plant. The report also presents summaries of prior EPA and Michigan Department of Natural Resources studies at the Dow Chemical-Midland Plant conducted during the period 1978 to 1985, including studies of Tittabawassee River native fish and sediments. The major findings of the report include: (1) confirmation of the discharge of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD or dioxin) from Dow Chemical to the Tittabawassee River; (2) bioaccumulation of 2378-TCDD in caged fish and native fish; (3) the estimated annual discharge loading of 2378-TCDD from Dow Chemical to the Tittabawassee River is 0.00012 kg (0.00026 lbs). Current-discharge levels have consistently been less than 10 parts per quadrillion (ppq), the interim discharge limit established by the Michigan Water Resources Commission and approved by EPA.

9368 **(PB—88-251384/XAB) Overview of sediment quality in the United States. Final report.** Lyman, W.J.; Glazer, A.E.; Ong, J.H.; Coons, S.F. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1987. 204p. NTIS, PC A10/MF A01.

This report provides an overview of sediment quality in waters of the United States. The focus is on describing qualitatively the nature and extent of contaminated sediments, i.e., bottom deposits in rivers, lakes, harbors and oceans that have been polluted with heavy metals, organic chemicals and other materials from anthropogenic sources. Such materials, also called in-place pollutants, may be significantly impacting aquatic ecosystems in some areas, and may be degrading the quality of the overlying water to the extent that water quality criteria are exceeded and that uses of the water - by both aquatic life and humans - are impaired. Major sections of the report provide information on: (1) the nature of sediment contamination problems; (2) sources of contaminated sediments; (3) available responses to sediment contamination; and (4) an overview of sediment quality criteria, used to classify sediments as polluted or not. There are appendices.

9369 **(PB—88-251764/XAB) Chemical and physical characteristics of lakes in the northeastern United States.** Brakke, D.F.; Landers, D.H.; Eilers, J.M. (Northrop Services, Inc., Corvallis, OR (USA)). 1988. 11p. NTIS, PC A03/MF A01.

Pub. in Environmental Science and Technology, Vol. 22, No. 2, 155-163(1988.

The chemical status of 768 lakes in the northeastern United States was determined as part of the Eastern Lake Survey. The lakes were selected statistically, allowing for estimates of the chemical conditions in the northeastern lake population on the basis of 26 measured parameters. The objectives were to estimate the numbers of acidic lakes in the Northeast and to describe associated chemical conditions in the lakes. The largest number of acidic lakes in the NE was estimated for the Adirondack area of NY; whereas the fewest acidic lakes were estimated to occur in Maine. Sulfate concentrations were lowest in Maine and highest in the Poconos Catskills, corresponding to the pattern in sulfate deposition.

9370 **(PB—88-870233/XAB) Acid precipitation: effects on fresh-water ecosystems. January 1978-September 1988 (Citations from the Life Sciences Collection data base). Report for January 1978-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 156p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the effects of acidification of fresh-water ecosystems. Algae and diatom distribution, survival, and reproduction rates of specific fish species under acid-lake conditions, and tolerance to stress caused by acidic conditions in fresh water ecosystems are studied. Effects of water ph on trace metal toxicity to fresh water organisms is briefly considered. Control and reduction of acidification is excluded from this bibliography. (Contains 290 citations fully indexed and including a title list.)

9371 **(PB—89-100887/XAB) Reducing lead in drinking water: a benefit analysis. Draft report (Final).** Levin, R. (Environmental Protection Agency, Washington, DC (USA). Office of Policy, Planning and Evaluation). Dec 1986. 350p. (EPA—230/09-86/019). NTIS, PC A15/MF A01.

An analysis estimates some of the benefits that could result from reducing exposure to lead in community drinking-water supplies. There are two primary categories of benefits evaluated: public-health benefits of reduced lead exposure and reduced materials damages relating to the phenomenon of lead's presence in drinking water. In addition, because the calculation of health benefits depends on the extent of human exposure, another chapter presents the available data on the occurrence of lead in public water supplies, and estimates of the population exposed to drinking water exceeding the proposed standard pf 20 ppb. In assessing the benefits of the proposed reduced lead standard, the analysis assumes that EPA will act to reduce lead levels in drinking water, as well as to maintain the current high quality of water leaving the treatment plant. It also relies upon assumptions about drinking water use and consumption patterns.

9372 **(PB—89-101901/XAB) Field application of parameter identification in ground-water contaminant-transport modeling: a case study. Report for 1 May 1986-31 March 1987.** Holmes, K.J.; Chu, W.S. (Washington Univ., Seattle (USA). Dept. of Civil Engineering). Jun 1987. 54p. NTIS, PC A04/MF A01.

Errata sheet inserted.

The application of a parameter identification (PI) algorithm in ground-water contaminant-transport modeling is attempted in the study. The computer code used was a combination of an ordinary least-square optimization routine and the United States Geological Survey's Method of Characteristics Code (USGS-MOC). In working with engineers and scientists from Washington State Department of Ecology and the consulting firm, Golder and Associates, a suitable field problem with adequate monitoring data was selected. Using available observations, the transmissivity and dispersivity were calibrated by both the PI approach and the more-conventional trial-and-error approach.

9373 **(PB—89-102206/XAB) Assessment of rural ground-water contamination by agricultural chemicals in sensitive areas of Michigan.** Ervin, J.L.; Kittleson, K.M. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). Apr 1988. 41p. NTIS, PC A03/MF A01.

The vulnerability of drinking-water supplies to agricultural contamination in three Michigan counties is discussed. The results of nitrate and atrazine analysis of drinking water from 38 wells in those 3 counties is described. Widespread nitrate contamination was demonstrated in agricultural areas with vulnerable aquifers. In addition, atrazine, a widely used herbicide was found in 11 of the 38 wells samples, with concentrations and patterns not conforming to findings in other mid-western states. The need for a comprehensive inventory of the ground-water quality in rural areas of Michigan is emphasized in the report, which describes results from the first year of a 2-year study.

9374 **(PB—89-102255/XAB) Development of innovative flotation processes for water treatment and waste-water reclamation. Technical report.** Krofta, M.; Wang, L.K. (Lenox Inst. for Research, Inc., MA (USA)). 1 Aug 1988. 44p. (LIR—08-88/312). NTIS, PC A03/MF A01.

The engineering designs and applications of various newly developed flotation clarifiers (Supracell, Sandfloat, Sedifloat, Lakeguard, Float Skimmer, and Foamer) are presented. Supracell is a

high-rate dissolved air flotation clarifier for industrial water-treatment and in-plant water recycle. Sandfloat is a package water treatment plant designed for treatment of surface water, ground water, or waste water. Sedifloat is a package plant from reclamation of process waste water or pretreatment of raw water containing heavy silts and/or high concentrations of suspended solids. Lakeguard is an extremely compact package plant for single families, factories, and small institutions. Both lake water and ground water can be properly treated by Lakeguard for potable applications and for treatment of septic-tank effluent. Foamer is a high-rate cost-effective dispersed air flotation clarifier. Float skimmer is specifically designed for applications in paper and pulp mills.

9375 **(PB—89-102321/XAB) Health-risk assessment of carbon tetrachloride (CTC) in California drinking water. Final report.** Reed, N.R.; Babapour, R.; Reed, W.; Beltran, L.; Hsieh, D.P.H. (California Univ., Davis (USA). Dept. of Environmental Toxicology). 17 May 1988. 173p. (UCD/ET—88/1). NTIS, PC A08/MF A01.

The purpose of this document is to provide information on the toxicity of carbon tetrachloride (CTC) and to estimate the exposure of California residents to CTC. The information provided will aid the California Department of Health Services in developing drinking-water standards for CTC. The four major contributions of the document are: (1) a review of the existing literature pertinent to the health risk from CTC contaminated drinking water; (2) an estimation of the CTC exposure for California residents; (3) a delineation of the level of CTC that may cause a noncarcinogenic health effect; and (4) an estimation of the cancer potency and lifetime cancer risk. Topics also discussed are: physical and chemical properties; mechanisms of toxicity; human exposure; health effects; and data gaps.

9376 **(PB—89-103170/XAB) Polychlorinated dioxin and furan discharge during carbon reactivation (journal version).** Lykins, B.W.; Clark, R.M.; Cleverly, D.H. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). 1988. 18p. (EPA—600/J-88/060). NTIS, PC A03/MF A01.

Pub. in Jnl. of Environmental Engineering, Vol. 114, No. 2, 300-316(Apr 1988).

Analyses are performed on samples collected from various effluent streams of a fluidized-bed and infrared furnace during reactivation of granular activated carbon (GAC) used in treatment of drinking water. These analyses show that polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are produced during GAC reactivation. No detectable concentrations of PCDD or PCDF are seen in the spent carbon fed to the reactivation furnaces. Although the total amount of organic halogens on the spent GAC ranges from 416-657 mg/kg, only small fractional amounts of PCDDs and PCDFs are formed. The low levels of PCDDS and PCDFs emitted into the atmosphere during GAC reactivation and the resulting cancer risks to the exposed population are minimal and negligible.

9377 **(PB—89-103329/XAB) Oxygen transfer under process conditions.** Mueller, J.A.; Boyle, W.C. (Manhattan Coll., New York (USA)). 1988. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of the Water Pollution Control Federation, Vol. 60, No. 3, 332-341(Mar 1988).

The report outlines five procedures used to evaluate oxygen transfer under process conditions. Steady- and nonsteady-state analyses, radioactive and nonradioactive tracer techniques, and off gas methods are evaluated in side-by-side comparisons at six municipal and industrial wastewater treatment plants employing both diffused and mechanical aeration.

9378 **(PB—89-104426/XAB) Empirical models for lake acidification in the Upper Great Lakes Region.** Rogalla, J.A.; Brezonik, P.L.; Glass, G.E. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1986. 9p. (EPA—600/J-86/486). NTIS, PC A02/MF A01.

Pub. in Water, Air, and Soil Pollution 31, 95-100(Jul 1986).

A large data base on inland lakes in the Upper Great Lakes Region (UGLR) was used to evaluate assumptions and relationships of empirical acidification models. Improved methods to calculate background alkalinity and background $SO_4^{2-}$ are reported; $SO_4^{2-}$ enrichment factors indicate that terrestrial $SO_4^{2-}$ sources and watershed or lake sinks must be considered for site-specific background $SO_4^{2-}$ estimates. Significant relationships were found between lake acidification estimated as change in $SO_4^{2-}$ and precipitation acidity but not between changes in lake alkalinity and precipitation acidity in the lightly impacted region.

9379 **(PB—89-110274/XAB) Performance of air stripping and GAC (granular activated carbon) for SOC (synthetic organic chemical) and VOC (volatile organic chemical) removal from ground water. Final report, October 1983-November 1987.** Hand, D.W.; Crittenden, J.C.; Miller, J.M.; Gehin, J.L. (Michigan Technological Univ., Houghton (USA)). Sep 1988. 97p. NTIS, PC A05/MF A01.

This study compares the ability and cost-effectiveness of granular activated carbon and packed-tower aeration (air stripping) in removing synthetic organic and volatile organic chemicals (SOCs and VOCs) from a contaminated groundwater source in Wausau, WI. Among the SOCs and VOCs identified and targeted for removal were cis-1,2-dichloroethene, trichloroethene, tetrachlorethene, and toluene. A liquid-phase GAC pilot-plant, full-scale GAS adsorber, and a full-scale air-stripping tower were designed, built, and operated to provide data so that the process performance could be evaluated. Extensive laboratory studies were performed. Mathematical models and correlations for obtaining kinetic parameters and single-solute isotherm parameters were developed and tested by comparing their results to those obtained from the pilot plant. Possible surrogate parameters were investigated. Cost estimates are compared.

9380 **(PB—89-110282/XAB) Determination and enhancement of anaerobic dehalogenation: degradation of chlorinated organics in aqueous systems. Summary report, October 1983-April 1987.** Palmer, D.T.; Linkfield, T.G.; Robinson, J.B.; Sharak Genthner, B.R.; Pierce, G.E. (Battelle Columbus Div., OH (USA)). Sep 1988. 59p. NTIS, PC A04/MF A01.

This report summarizes initial efforts: to isolate microorganisms capable of anaerobic dehalogenation; to examine the nutritional requirements of dehalogenating enrichments and a dehalogenating consortium; and to study the genetics of dehalogenation. Enrichments using secondary anaerobic digestor sludge containing either 3- or 4-chlorobenzoate were established with a variety of terminal electron acceptors. Degradation of 4-chlorobenzoate was not observed. Degradation of 3-chlorobenzoate (3CB) was observed after 10-23 weeks. Use of a 3CB degrading consortium revealed that the microorganisms capable of benzoate degradation and methanogenesis were lost but dechlorination continued. Genetic studies using a pure culture of strain DCB-1 found the strain to be suitable for cloning manipulations.

9381 **(PB—89-115570/XAB) Investigation of novel adsorptive-separation methods for removal of trace heavy metals from polluted areas. Technical report.** Carleson, T.E.; Moussavi, M. (Idaho Univ., Moscow (USA). Dept. of Chemical Engineering). May 1988. 31p. NTIS, PC A03/MF A01.

The removal of trace amounts of cadmium and zinc from waste-water samples from the Bunker Hill mine and from synthetic waste-waters was evaluated. The heavy metals were chelated with the surfactants sodium lauryl sulfate, sodium lauryl benzene sulfate, and cetyl pyridinium chloride. The chelated metals were then separated by the generation of a form with sparged air or dissolved air. As much as 95% of the metal entering the foam generation unit was removed and carried out with the foam. The foam constituted about 25% of the feed. The removal efficiency was correlated with feed flow rate and foam drainage height by means of a simple equilibrium model. Qualitative predictions based upon the model fit the experimental results, although quantitative agreement was not good. Recommendations for further experimental work are presented.

9382 **(PB—89-850358/XAB) Activated charcoal. January 1970-October 1988 (Citations from the Compendex data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 83p. NTIS PC N01/MF N01.

Supersedes PB—88-850391.

This bibliography contains citations concerning theoretical aspects and industrial applications of activated charcoal. Topics include absorption capacity and mechanism studies, kinetic and thermodynamic aspects, and properties descriptions and evaluations. Applications include utilization in water analyses and waste treatment, air pollution control and measurement, and in nuclear facilities. (This updated bibliography contains 150 citations, 14 of which are new entries to the previous edition.)

9383 **(PB—89103931/XAB) Comparison of oxygen-transfer test methods in a Total Barrier Oxidation Ditch configuration.** Borneman, R.C. (BCM Converse, Inc., Mobile, AL (USA)). Oct 1988. 411p. NTIS, PC A18/MF A01.

The Total Barrier Oxidation Ditch (TBOD), a recent development in oxidation ditch technology is described. The study was carried out in 1986 and 1987 for the purposes of: (1) evaluating the applicability of selected test procedures developed by the American Society of Civil Engineers (ASCE) Committee on Oxygen Transfer for estimating oxygen transfer of a circulating oval aeration basin, as represented by the TBOD configuration; and (2) generating reliable clean and process-water oxygen-transfer data on two TBOD's at Opelika, Alabama, and South Hill, Virginia. The methods used in the clean water test program included the ASCE nonsteady-state procedure, the krypton/tritium radiotracer procedure, and a technique in which a dissolved-oxygen mass balance is performed across the aeration device. In the process-water test program, methods utilized included off-gas analysis and the above radiotracer procedure at both sites plus a process oxygen consumption/oxygen supply mass balance at one of the sites.

9384 **(PB—89109938/XAB) Persistent marine debris in the North Sea, Northwest Atlantic Ocean, Wider Caribbean Area, and the West Coast of Baja California. Final report.** Heneman, B. (Henneman (Burr), Bolinas, CA (USA)). Jul 1988. 160p. NTIS, PC A08/MF A01.

Information on persistent marine debris (including plastics, glass, metal, and tar) in four study areas (North Sea, northwest Atlantic Ocean, Wider Caribbean Area, and the west coast of Baja California) was obtained through literature searches, a mailed survey, correspondence, interviews, and personal observations. All of the study areas except Baja California were found to have severe marine debris problems.

9385 **(PB—89110134/XAB) Granular activated-carbon adsorption with on-site infrared furnace reactivation. Final report.** Koffskey, W.E. (Jefferson Parish Dept. of Public Utilities, LA (USA)). Sep 1988. 178p. NTIS, PC A09/MF A01.

The costs associated with the design, construction, operation, and maintenance of three 1 million gallons per day (mgd) granular activated-carbon (GAC) pressure contactors and reactivation system were evaluated over a 2.4-year operational period. The reactivation system was comprised of a Shirco infrared reactivation furnace, three GAC storage tanks, and a water-slurry GAC transport system. Operation and maintenance costs, excluding amortized capital costs, were determined to be 20 cents/lb of reactivated GAC or 14 cents/1,000 gal of treated water. Adsorption performance of the reactivated GAC was equal to or greater than that of virgin GAC for all parameters monitored. The GAC loss observed during reactivation averaged 8.6% and was comprised of 7.1% reactivation loss and 1.5% transport loss. The effluent streams of the infrared reactivation furnace were examined for the presence of polychlorinated dibenzodioxins and polychlorinated dibenzofurans. While trace levels of some of these substances were observed, a risk assessment indicated a maximum lifetime risk of three in 1 billion for the existing facility.

9386 **(UBA-FB—87-049) Choice of test organisms for determination of oil dispersant toxicity in marine waters.** Henke, G.A. (Umweltbundesamt, Berlin (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Biologische Anstalt Helgoland, Hamburg (Germany, F.R.)). Jun 1987. 95p. (In German). NTIS, PC Exx; Available from NTIS as TIB.

Several marine organisms were investigated regarding their qualification for oil dispersant toxicity determination. Appropriate organisms were chosen for two different test procedures: Using mortality as a test criterion an acute toxicity test can be carried out very easy with larvae of the brine shrimp Artemia sp. The sensitivity for different dispersants ranges over several orders of magnitude. Another test indicator is the cell multiplication-inhibition test, conducted with the microalga Scrippsiella trochoidea, a representative of phytoplankton. The sensitivity for a common dispersant ranges a hundredfold higher than the acute toxicity test. Both test procedures are also practicable for other water-soluble substances, as well. One oil-spill dispersant efficiency test is proposed provisionally. (orig.) With 62 refs., 20 tabs., 11 figs.

9387 **(UCID—21008-Vol.7) Evaluation of military field-water quality: Volume 7, Performance evaluation of the 600-gph reverse osmosis water purification unit (ROWPU): Reverse osmosis (RO) components.** Marinas, B.J.; Ungun, Z.; Selleck, R.E. (Lawrence Livermore National Lab., CA (USA)). Feb 1986. Contract W-7405-ENG-48. 219p. NTIS, PC A10/MF A01 - OSTI. Order Number DE89004858/JAW.

The primary purpose of this work is to ascertain whether the performance of the current 600-gph reverse osmosis water-purification unit (ROWPU) is adequate to meet the water-quality standards recommended in Volume 4 of this study. A secondary objective is to review the design of the treatment units used in the ROWPU, as well as the prescribed mode of operation, and to make constructive recommendations. Reverse osmosis (hyperfiltration) is a complicated water-treatment process that is not described easily with a few process parameters. Furthermore, published literature on the type of membrane currently used in the ROWPU was scarce. Therefore, we required a mathematical model that could be used to extrapolate existing information to different operating conditions. It was successful for seawater and single-salt solutions, but it proved to be unsuccessful for just any mix of salts that might be encountered in nature. 99 refs., 69 figs., 60 tabs.

9388 **(UCRL—21008-Vol.6) Evaluation of military field-water quality: Volume 6, Infectious organisms of military concern associated with nonconsumptive exposure: Assessment of health risks and recommendations for establishing related standards.** Cooper, R.C.; Olivieri, A.W.; Danielson, R.E.; Badger, P.G. (Lawrence Livermore National Lab., CA (USA)). Feb 1986. Contract W-7405-ENG-48. 214p. NTIS, PC A10/MF A01 - OSTI. Order Number DE89004551/JAW.

This study is an assessment of the risk of illness due to exposure to water-related (i.e., water-based, water-washed) infectious organisms. The organisms under consideration are Aeromonas spp., Leptospira spp., Pseudomonas spp., Staphylococcus spp., non-cholerae Vibrio spp., Acanthamoeba spp., Balantidium coli, Naegleria spp., Ascaris lumbricoides, Dracunculus medinesis, Schistosoma spp., and the agents responsible for cercarial dermatitis (i.e., Trichobilharzia, Gigantobilharzia, and Austrobilharzia). Evaluation of the risk to disease associated with the above pathogens requires information in specific areas such as dose response, concentration of agents in the environment, and environmental persistence. The existing body of knowledge concerning these agents ranges from speculation to established fact. Unfortunately, areas of information critical to risk assessment are frequently unavailable. Because of this lack of data, the risk assessment presented is semiquantitative and limited to the presentation of an environmental classification scheme. 14 refs., 2 figs., 57 tabs.

9389 **Microbiological cleanup of groundwater contaminated by pentachlorophenol.** Frick, T.D.; Crawford, R.L.; Martinson, M.; Chresand, T.; Bateson, G. (Univ. of Minnesota, Navarre (USA)). pp 173-191 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

This study was undertaken to determine the feasibility of designing a large bioreactor, modeled after the authors small benchtop bioreactor, to decontaminate groundwater at a site where an aquifer had been contaminated with PCP. The PCP-degrading microorganisms in the original bioreactor had been immobilized in a biofilm covering the rock surfaces. Use of such an immobilized biofilm allowed the flow rate through the column to be greater than the growth rate of the microorganisms in the column, without causing washout of the microorganisms. The study was carried out in four phases. In the first phase they examined a number of materials for their suitability as support matrices for immobilizing the biofilm. In the second phase, the active biofilm (a microbial consortium capable of degrading PCP) was transferred from their benchtop bioreactor to a large volume of support material. The bioreactor vessel was designed and constructed during this phase. During the third phase of the study the bioreactor was assembled in their pilot plant, and the biofilm was developed in situ. In the final phase of the study, the bioreactor was installed in the field and tested with real world PCP-contaminated groundwater.

9390 **Complex industrial waste sites.** St. John, W.D.; Sikes, D.J. (Ecova Corporation, Redmond, WA (USA)). pp 237-252 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The biodegradation and transformation of contaminants at complex toxic waste sites represents one of the largest and most challenging problems facing the biotechnology industry. A complex waste site is defined here as a site with a large number of diverse toxic compounds contained in a difficult substrate. The challenge is to determine how to design and apply effective biological treatments in the field. This chapter presents two case studies which includes chemical and physical treatment strategies. In case 1, a groundwater plume contaminated with a complex mixture of chlorinated and nonchlorinated solvents stretches across property boundaries and underneath an adjacent building. In case 2, hazardous organic compounds are contained in a clay soil. The contaminants include a diverse mixture of chlorinated and nonchlorinated volatile compounds and a number of polyaromatic hydrocarbons. The concentration of volatile organic compounds (VOCs) varies dramatically in the clay matrix, from less than a few ppb to several thousand ppm. In each of these studies, the authors begin with a site assessment to define the types and quantity of contaminants. The objective is to determine whether indigenous microorganisms can provide and acceptable level of contaminant destruction. This biotreatability assessment is performed under laboratory conditions optimized to promote biodegradation of the contaminants.

9391 **Anaerobic fluidized-bed treatment of hazardous wastes.** Suidan, M.T.; Nakhla, G.F. (Univ. of Illinois, Urbana (USA)). pp 295-306 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The use of granular activated carbon (GAC) as a medium in expanded-bed anaerobic reactors results in a process capable of effecting excellent treatment efficiencies, while at the same time providing resistance to fluctuations in feed composition, flow rate, and strength. The expanded-bed GAC anaerobic reactor has been demonstrated to be a viable process for the treatment of a variety of wastewater, ranging from prepared solutions of phenols, volatile fatty acids, and mixtures of polycyclic nitrogen-containing aromatic compounds, to industrial wastewaters generated during coal coking and gasification, petroleum refining, and paint stripping operations. Throughout these studies, good contaminant removal efficiencies were maintained while high organic loading rates and low empty-bed hydraulic detention times were achieved. Granular activated carbon appears to be superior to other reactor media in terms of microbial attachment and sheltering properties. Lower contaminant concentrations and fewer suspended solids were found in effluents from reactors in which GAC was used as compared to units utilizing sand, anthracite, or nonactivated carbon.

## 5203 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 7457, 7479, 7481, 7493, 7828, 7835, 7918, 9273, 9277, 9324, 9507*

9392 **(BfG—0363) Effects of the Chernobyl reactor accident on the surface waters in West Germany. Pt. 3.** Mundschenk, H. (Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.); Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). 31 Oct 1986. 24p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755933/JAW.

There was only a very short time delay between the release of radioactivity from the reactor and the washout or fallout in different parts of West Germany, which has led to surface water contamination at different levels, detected and monitored by the WSV water monitoring network. The radioactivity measurements at the various sampling stations are reported and shown in tables, giving levels and time-dependent changes of radioactivity uptake in the various regions. A very extensive measuring programme for water monitoring has been carried out in West Berlin. At a very large number of sampling stations at lakes, rivers and channels, water and sediment samples have been taken at regular intervals in the period between beginning of May and October 1986, and have been analysed for the relevant radionuclides (I-131, Cs-137). The measured data have been reported to the coordinating center in evaluated, tabular form. Comprehensive data of this kind have been sent to the coordinating center by the Lands Lower Saxony, Schleswig-Holstein and Hesse, covering primarily the period May to July. Some other measuring data reported from Rhineland Palatinate, North-Rhine Westphalia and the Saarland, taken at irregular intervals and over a shorter period of time, are also given in this survey.

9393 **(BfG—0413) Water and tritium balance of the Ems region, 1951 through 1983.** Krause, W.J. (Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.)). Mar 1988. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756180/JAW.

The distribution of tritium flows was presented in tabular form for this period of time by means of monthly and annual values in the form of tritium contents and tritium transports for the individual component flows and interpreted by means of graphical representations. The contributions of the Northwest German canal system to the tritium input and discharge and the tritium emission from the nuclear power station 'Lingen' were also considered, whose shares refered to the inland Ems area only amount to approximately 2% or max. 1% of the tritium load. The most important tritium flows are the tritium evaporation with a mean value of 65% over many years, the tritium load with 28% and the tritium decompostion with 6.5% compared with the impact (100%). The division of the tritium discharge between groundwater discharge and direct discharge amounts, on average, to approximately 2 to 3; this ratio can drastically shift in the case of heavy changes of the tritium input. The applied balance model describes the groundwater by 4 compartments on the basis of data extrapolated and measured for surface water.

9394 **(DOE/FTR—9003562) [Conference on radionuclides in the food chain, Laxenburg, Austria, and visit to Service Central de Protection, Le Vesinet, France, October 30--November 12, 1987]: Foreign trip report.** Hull, A.P. (Brookhaven National Lab., Upton, NY (USA)). 14 Dec 1987. Contract AC02-76CH00016. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003562/JAW.

The principal purpose of this travel was to attend the International Conference on Radionuclides in the Food Chain which took place on November 1–5, 1987 at Laxenburg, Austria. The Conference brought together some 170 attendees (about evenly divided between radiological and food-related interests) to discuss the pathways of deposited radionuclides to foods, their assessment in foods, the development and harmonization of norms and intervention levels for them, and their regulatory application. While previous incidents which related similar concerns (the Windscale accident, deposition of fallout from atmospheric weapons testing, and the Three Mile Island (TMI) accident) were reviewed, the Chernobyl accident was the principal stimulus for the Conference. Background information on previous Soviet radio-ecological investigations and updated information on the consequences of the Chernobyl accident and their management were presented in English by six Soviet investigators. A paper which was to have been presented by Academician Ilyin on "Biomedical Aspects of the Chernobyl Accident," is also reviewed.

9395 **(FRCEA-TH—145) Radioecological synthesis of the various compartments of La Hague (Cotentin) marine environment.** Calmet, D. (Aix-Marseille-2 Univ., 13 - Marseille (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Mar 1986. 263p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88756018/JAW.

Permits for low level radioactive liquid waste releases by the LA HAGUE (Cotentin, France) fuel reprocessing plant are based on an accurate radioecological study of the marine environment. Since 1967, the monitoring of indicators such as seawater, sediments and marine organisms (Fucus serratus, Laminaria sp., Mytilus sp., ...) have made it possible to create an important environmental data base. A statistical treatment has been used to quantify the spatio-temporal (daily, seasonal, local and regional) variabilities of these indicators from 1975 up to now. It has demonstrated the interest of F. serratus seaweed as bioindicators of radioactivity. Moreover it appears that seawater-soluble radionuclides such as / sup 125/Sb and /sup 137/Cs are monitored through longer distance from the outlet than those bound to particles such as /sup 144/Ce. A study of the sestonic load by satellite images suggested a number of geographical sites of potential accumulation through particle transport, some of which were verified by radioactivity measurements of sediments. However, such accumulation was not confirmed by the particle size distribution at the level of the Cap de LA HAGUE associated with radioactive measurements of seawater. A spectral analysis of biota radioactive levels vs radioactive waste releases showed a time delay of 2 - 4 months for F. serratus and Mytilus sp. collected in the local area of LA HAGUE after either an increase or a decrease of the releases. Modeling of marine currents fields associated with a transfer model can now be used to predict, at small time scales, the radioactivity levels inthe various Cotentin marine compartments from the liquid waste releases.

9396 **(INFO—0222) Mechanical dispersion in fractured crystalline rock systems.** Lafleur, D.W.; Raven, K.G. (INTERA Technologies, Ottawa, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1986. 73p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705129/JAW.

This report compiles and evaluates the hydrogeologic parameters describing the flow of groundwater and transport of solutes in fractured crystalline rocks. This report describes the processes of mechanical dispersion in fractured crystalline rocks, and compiles and evaluates the dispersion parameters determined from both laboratory and field tracer experiments. The compiled data show that extrapolation of the reliable test results performed over intermediate scales (10's of m and 10's to 100's of hours) to larger spatial and temporal scales required for performance assessment of a nuclear waste repository in crystalline rock is not justified. The reliable measures of longitudinal dispersivity of fractured crystalline rock are found to range between 0.4 and 7.8 m.

9397 **(INFO—0223) Hydrogeologic factors to be addressed in disposal guidelines.** Lafleur, D.W.; Raven, K.G. (INTERA Technologies, Ottawa, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1986. 136p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705130/JAW.

This report identifies the physical hydrogeologic factors that should be addressed for performance assessment of a radioactive waste disposal facility in plutonic rock. The hydrogeologic factors include theoretical methods, groundwater flow factors and solute transport parameters. Theoretical methods, including different deterministic and stochastic approaches for evaluating physical hydrogeolgic conditions, are evaluated with respect to data requirements, applications and limitations. Preferred methods for measurement and determination of the identified groundwater flow factors and solute transport parameters are discussed. A recommended set of procedures for reliable hydrogeologic characterization of a plutonic rock mass at both regional and site scales is also presented.

9398 **(LUTFD2-TFKF—3054-1-8-1988) Activity concentration of various radionuclides in tubificids living in the biobeds of a sewage treatment plant.** Erlandsson, A.; Erlandsson, B.; Mattsson, S. (Lund Univ. (SE). Dept. of Animal Ecology; Lund Univ. (SE). Dept. of Nuclear Physics; Lund Univ. (SE). Dept. of Radiation Physics). (Lund Univ. (Sweden). Dept. of Nuclear Physics). Apr 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756199/JAW.

Oligochaeta belonging to the family Tubificidae are used in the biobeds of waste water treatment plants in the decomposition process of organic matter. Waste water treatment plants also receive radionuclides in the form of radiopharmaceuticals. The most commonly used radionuclides are /sup 131/I and /sup 99/Tc/sup m/. In this investigation the role of the Tubificids in the accumulation of these radionuclides has been studied. The activity concentration of /sup 131/I in Tubificids was found to be 1-20 times higher than in the incoming waste water which is only 5-20% of the concentration factor between incoming water and outgoing sludge. Sludge is thus a more sensitive bioindicator, but Tubificids respond faster. (authors).

9399 **(PB—89-110126/XAB) Manganese dioxide-coated filters for removing radium from drinking water. Report for 19 September 1983-1 September 1987.** Menetrez, M.Y.; Anderson, D.G.; Stahel, E.P. (North Carolina State Univ., Raleigh (USA)). Sep 1988. 110p. NTIS, PC A06/MF A01.

Research was performed using manganese dioxide ($MnO_2$) to demonstrate that above pH3 cations are adsorbed from solution in the order of their affinity, and that the interaction is characterized by the pH dependence of the metal. The relationship of the zero-point charge of pH and the solution ionic strength effects on interfacial surface potential and adsorption were addressed. Characteristics of $MnO_2$ behavior, structure, and stability found in research investigation were reviewed. Most of the study was on the use of $MnO_2$ coated filters for the removal of radium. A few comparison tests on radium removal with ion exchange were also made. Specifically, these tests have shown that acrylic-fiber filters coated with $MnO_2$ will remove radium from water. For a high-hardness water with pH = 7.4, total radium removal was 14,200 pCi/g $MnO_2$ before the MCL of 5 pCi/L was exceeded, and for a low-hardness water with pH = 4.5, total radium removal was 5000 pCi/g $MnO_2$ before the MCL of 5 pCi/L was exceeded. Hardness passed through the $MnO_2$ filters with little change and, therefore, radium was highly preferred over hardness. A step-by-step process for the preparation of acrylic-fiber filters coated with $MnO_2$ was designed and operated successfully.

9400 **(SKB-TR—87-30) Water compositions in the Lake Sibbofjaerden - Lake Trobbofjaerden area.** Andersson, K. (Studsvik Energiteknik AB, Nykoeping (SE)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Aug 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756204/JAW.

The recipient evolution project aims at achieving an understanding of the processes occurring within a lake and its sediments

during the life-time of the lake in order to permit predictions of long-term behaviour of radionuclides released into lake sediments. An experimental program concerning field investigations in the drainage areas of Lake Sibbofjaerden and Lake Trobbofjaerden has been performed. This report covers the chemical analyses of surface and sediment pore waters as well as a study of trace radionuclide sorption in sediments. Chemical data for surface water and sediments from several different types of lakes and streams have been collected. The chemical composition of the sediment pore water seems to be strongly related to the lake water composition in the upper layers, while changes, mainly in the ionic strength are occurring with increasing depth. The next phase of this report will be focused on the development of a mathematical model, describing the time-dependent processes of importance to the turn-over of radionuclides during the various phases of the evolution of a lake. Processes of chemical nature of large importance here are e.g. sorption of radionuclides on suspended material in the water, and migration and fixation in the sediment. The chemical analyses described in this report give a data-base for use in connection with the modelling.

9401 **(SSI—87-18) Measuring of uranium in sediments from Vinterviken.** Suomela, J.; Bergman, C.; Notter, M. (Statens Straalskyddsinstitut, Stockholm (SE); Statens Naturvaardsverk, Drottningholm (SE)). (National Inst. of Radiation Protection, Stockholm (Sweden)). Jun 1987. 21p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755687/JAW.

During the nineteen fifties and sixties radiological activities were pursued in premises at Vinterviken in Stockholm. The activities consisted of experiments on leaching of uranium from Swedish shales and of work on residues from the leachings. The work comprised bench-scale experiments and pilot plants. Some residues were sluiced to the Vinterviken bay through waste pipes. Measurements of the sediments show a marked increase of the uranium content in the sediment layers formed during the nineteen fifties. However, the percentages are too low to be of any health hazard. The measurements also reveal the results of the atmospheric nuclear weapons tests in the nineteen fifties and sixties as an increase of the cesium 137 content. (O.S.).

## 5204 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 7589, 7704, 7705*

## 5205 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 7574, 7575, 7577, 7578, 7579, 7580, 7581, 7589, 8048, 8049, 9343, 9559, 9630*

9402 **(PB—89-108963/XAB) Developing a mathematical-model system for the Rhine: Meuse estuary.** Roelfzema, A.; Perrels, P.A.J.; Scholten, W.N.G.; Wekken, A.V.D. (Waterloopkundig Lab. te Delft (Netherlands)). Nov 1987. 25p. (PUB—384). NTIS, PC E03/MF A01.

The paper deals with the development of a mathematical model system consisting of flow models, morphological models and water-quality models. In such a development, automation-related aspects and organizational aspects play an essential role. Experiences and recommendations on these aspects are presented.

9403 **Recruitment dynamics in complex life cycles.** Roughgarden, J.; Gaines, S.; Possingham, H. (Stanford Univ., CA (USA)). *Science (Washington, D.C.);* **241**: 1460-1466(16 Sep 1988). Contract FG03-85ER60362.

Organisms living in the marine rocky intertidal zone compete for space. This, together with predation, physical disruption, and differing species tolerances to physiological stress, explains the structure of the ecological communities at some sites. At other sites the supply of larvae is limiting, and events in the offshore waters, such as wind-driven upwelling, explain the composition of intertidal communities. Whether the community ecology at a site is governed by adult-adult interactions within the site, or by limitations to the supply of larvae reaching the site, is determined by the regional pattern of circulation in the coastal waters. Models combining larval circulation with adult interactions can potentially forecast population fluctuations. These findings illustrate how processes in different ecological habitats are coupled.

## 5206 Regulations

*REFER ALSO TO CITATION(S) 8043, 9280, 9288, 9335, 9336, 9337, 9375, 9546, 9547, 9558*

9404 **(PB—88-245964/XAB) Report of the National Workshop on Instream Biological Monitoring and Criteria held in Lincolnwood, Illinois on December 2-4, 1987.** (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1988. 44p. (EPA—600/9-88/016). NTIS, PC A03/MF A01.

The purpose of the workshop was to assess the role of biocriteria and information generated by ambient biological sampling in the State and Federal surface-water programs. The workshop was convened, in part, in response to the Water Quality Act (WQA) of 1987, Sec. 303(c)(2)(B), which requires US EPA to develop criteria based on biological assessment methods when numerical criteria are not established for the priority pollutants listed in Section 307(a) of the Clean Water Act (CWA); and in part to bring together a nationwide group of aquatic biologists and water resource managers who are presently developing and/or applying biocriteria to protect or restore the Biological integrity of the nation's waters. The report summarizes the recommendations of the workshop and illustrates to regulatory agencies that biosurveys are an important monitoring and evaluation tool.

9405 **(PB—88-246236/XAB) Maryland long-term stream-chemistry monitoring program.** (International Science and Technology, Inc., Reston, VA (USA)). Apr 1988. 281p. NTIS, PC E99.

Set includes Volume 1, PB—88-246244 through Volume 4, PB—88-246277.

A separate abstract was prepared for each of the 4 volumes of this set.

9406 **(PB—88-246244/XAB) Maryland long-term stream-chemistry monitoring program. Volume 1. Program design.** Knapp, C.M.; Filbin, G.J.; Bonoff, M.B. (International Science and Technology, Inc., Reston, VA (USA)). Apr 1988. 56p. NTIS, PC A04/MF A01.

See also Volume 2, PB—88-246251; Also available in set of 4 reports PC E99, PB—88-246236.

The Maryland Long-term Stream Chemistry Monitoring Program is presented in four volumes covering design, quality assurance and quality control, field methods, and laboratory methods. The Program has two major elements; intensive monitoring to detect changes in baseflow stream chemistry, episodic stream-chemistry responses to hydrologic events, and watershed stream chemistry budgets; and extensive monitoring to detect statewide changes in the number and distribution of acidic and acid-sensitive streams in Maryland. Implementation requirements for intensive and extensive monitoring are presented, as well as methods for analyzing all data collected in the Program.

9407 **(PB—88-246251/XAB) Maryland long-term stream-chemistry monitoring program. Volume 2. Quality Assurance Plan.** Knapp, C.M.; Filbin, G.J.; Bonoff, M.B. (International Science and Technology, Inc., Reston, VA (USA)). Apr 1988. 51p. NTIS, PC A04/MF A01.

See also Volume 1, PB—88-246244, and Volume 3, PB—88-246269; Also available in set of 4 reports PC E99, PB—88-246236.

The Quality Assurance Plan for the Maryland Long-Term Stream Chemistry Monitoring Program (hereinafter referred to as the Program), establishes the quality-assurance goal and objectives of the program. It presents detailed standards for acceptable performance of field and laboratory equipment, and presents procedures for evaluation and control of the performance of field, laboratory, and data-base-management activities during the program.

9408 **(PB—88-246269/XAB) Maryland long-term stream chemistry monitoring program. Volume 3. Field Methods Manual.** Knapp, C.M.; Filbin, G.J.; Bonoff, M.B. (International Science and Technology, Inc., Reston, VA (USA)). Apr 1988. 38p. NTIS, PC A03/MF A01.

See also Volume 2, PB—88-246251, and Volume 4, PB—88-246277; Also available in set of 4 reports PC E99, PB—88-24623.

The Field Methods Manual for the Maryland Long-Term Stream Chemistry Monitoring Program (hereafter referred to as the Program) describes protocols and guidelines for water quality and hydrological monitoring of the selected streams. It details a rigorous monitoring program designed to maximize the ability to detect changes in key hydrological, physical, and chemical parameters that are related to the potential effects of acidification on stream resources. The primary objectives of the field activities described in the manual are to ensure consistency in sample and data collection, to maintain sample integrity in the field, and to provide and maintain a high degree of quality control and quality assurance.

9409 **(PB—88-246277/XAB) Maryland long-term stream-chemistry monitoring program. Volume 4. Laboratory Methods Manual.** Knapp, C.M.; Filbin, G.J.; Bonoff, M.B. (International Science and Technology, Inc., Reston, VA (USA)). Apr 1988. 136p. NTIS, PC A07/MF A01.

See also Volume 3, PB—88-246269; Also available in set of 4 reports PC E99, PB—88-246236.

The Laboratory Methods Manual for the Maryland Long-Term Stream Chemistry Monitoring Program (the Program) describes protocols and guidelines for laboratory analyses, sample handling, laboratory quality assurance/quality control, and standard laboratory practices and procedures. It includes analytical methods, laboratory quality-control and quality-assurance procedures, and safety procedures for laboratory personnel.

9410 **(PB—88-246608/XAB) Fiscal Year 1987 program report: South Carolina Water Resources Research Institute.** (Clemson Univ., SC (USA). Water Resources Research Inst.). Jun 1988. 42p. NTIS, PC A03/MF A01.

See also report for Fiscal Year 1986, PB—87-223954.

Included in the report are sections on the water problems and issues of the State, the goals and priorities of the total program, the synopses of the program projects, and information concerning the information-dissemination program. The synopses contain information regarding research projects funded by the Water Resources Research Institute.

9411 **(PB—88-248984/XAB) Review of a framework for improving surface-water monitoring support for decision making. Report of the Environmental Effects, Transport and Fate Committee. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 1 Dec 1987. 46p. (SAB/EETFC—88/006). NTIS, PC A03/MF A01.

The EPA Surface Water Monitoring Subcommittee concludes that the study provided a strong conceptual framework for a sound monitoring program, but recommends certain refinements to further strengthen both the study and the monitoring program. The study's strength is its recognition of the need for change and the underlying concept to create that change. In addition, the planning and development approach used in the study solicits input from diverse sources and assesses that input, identifying both obstacles and challenges, to provide a useful framework for action. A major weakness results from the study's relatively narrow base of information. The Subcommittee identified several areas in the study that need further consideration or additional emphasis. Details are summarized.

9412 **(PB—88-251582/XAB) Regulatory impact analysis: benefits and costs of proposed surface water treatment rule and total coliform rule.** (Miller (Wade) Associates, Inc., Arlington, VA (USA)). 1 Sep 1987. 328p. NTIS, PC A15/MF A01.

Errata sheets inserted. Portions of this document are not fully legible.

This report contains an analysis of the costs and benefits of controlling microbial contaminants in drinking water through the promulgation of two regulations: (1) the Surface Water Treatment Rule (SWTR); and (2) the Total Coliform Rule. This regulatory impact analysis (RIA) was prepared in accordance with Executive Order 12291, which requires that the costs and benefits of all major rules be examined and compared. The major topical areas covered in the RIA are as follows: problem definition; market imperfections, the need for federal regulation, and consideration of regulatory alternatives; assessment of total costs; assessment of benefits; regulatory flexibility act and Paperwork Reduction Act analyses; and a summary of costs and benefits.

9413 **(PB—89-102081/XAB) Drinking-Water Standards and Regulations. Volume 2. Manual for 1982-88.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 10 Apr 1988. 335p. (LIR—04-88/297). NTIS, PC A15.

See also PB—88-178058 and PB—89-102099. Portions of this document are not fully legible.

The following 11 important documents are compiled for Drinking Water Standards and Regulations: (1) U.S. Environmental Agency Water Programs, National Interim Primary Drinking Water Regulations; (2) New Jersey Safe Drinking Water Act; (3) Summary of New Jersey Drinking Water Standards; (4) U.S. Environmental Protection Agency Safe Drinking Water Act of 1986 Amendments; (5) U.S. Environmental Protection Agency National Primary Drinking Water Standards; (6) Canadian National Health and Welfare Drinking Water Quality Guidelines--Maximum Acceptable Concentrations; (7) U.S. Environmental Protection Agency, National Primary Drinking Water Regulations, Filtration and Disinfection Turbidity, Giardia Lamblia, Viruses, Legionella, and Heterotrophic Bacteria; (8) Public Water Supply Manual--Guide to the Safe Drinking Water Program; (9) Public Water Supply Manual--Emergency Response; (10) U.S. EPA Approved Krofta Chemicals; (11) NY-DOH Approved Krofta Chemicals.

9414 **(PB—89-102099/XAB) Drinking water standards and regulations. Volume 3. Manual for 1978-1988.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 15 Apr 1988. 341p. (LIR—04-88/299). NTIS, PC A15/MF A01.

See also Volume 2, PB—89-102081. Portions of this document are not fully legible.

The following 12 important documents are compiled for a manual entitled Drinking Water Standards and Regulations: (1) Rules and Regulations for Public Water Systems; (2) Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems; (3) Questions and Answers About Water Operator Certification; (4) Application for Certification of Drinking Water Testing Laboratories; (5) Application for Public Water Supply Permit; (6) Pennsylvania Department of Environmental Resources--Safe Drinking Water Regulations; (7) EPA Guidelines for Submitting Petitions for Materials/Contact Surfaces Intended for Drinking Water Contact; (8) Drinking Water Technical Assistance--Disposition of the Federal Drinking Water Additives Advisory Program; Development of a Private Sector Voluntary Standard Organization; (9) Critical Elements for Certification of Laboratories for Chemistry; (10) Public Water Supply Guide--Coagulant Aids and Filter Aids; (11) Public Water Supply Guide--Corrosion Inhibitors and Sequestering Agents; (12) Standards Application Form CP 1--Construction Related and Discharge Permits.

9415 **(PB—89-102289/XAB) Standards and guides of water treatment and water-distribution systems. Volume 2. Manual for 1987-1988.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 15 Apr 1988. 260p. (LIR—04-88/300). NTIS, PC A12/MF A01.

See also PB—88-177902.

The following 6 important documents are compiled for design of municipal water treatment facilities and water distribution systems: (1) Standards of the Construction of Public Community Water Systems; (2) Community System Design Standards; (3) Bottled Water, Bulk Water Hauling and Vending Machines; (4) Noncommunity System Design Standards; (5) Operation and Maintenance; and (6) Cross-Contamination Control.

**9416 (PB—89-103352/XAB) Modeling distribution-system water quality: dynamic approach.** Grayman, W.M.; Males, R.M.; Clark, R.M. (Environmental Protection Agency, Cincinnati, OH (USA). Drinking Water Research Div.). 1988. 20p. (EPA—600/J-88/048). NTIS, PC A03/MF A01.

Pub. in Jnl. of Water Resources Planning and Management, Vol. 114, No. 3, 295-312(May 1988).

Interest is growing in determining the quality variations that exist in drinking-water distribution systems. The paper is dedicated to understanding distribution-system quality issues and to the development of a model that will enhance this understanding. A dynamic algorithm that can be used to predict water-quality variations is described in this paper. Determination of the blending of flows from separate sources, tracing of transient concentrations in the system, and establishment of a compliance monitoring system are only a few of the potential uses of such a model. The model was implemented on a microcomputer and applied to the North Penn Water Authority distribution system. Lansdale, Pennsylvania. It shows good correspondence with observed field data.

**9417 (PB—89-103717/XAB) National marine pollution program: summary of federal programs and projects: FY 1986 update.** (National Marine Pollution Program Office, Rockville, MD (USA)). Nov 1987. 578p. NTIS, PC A25/MF A01.

See also report for 1985, PB—87-202404.

The report is published annually by NOPPO to provide information on Federal marine pollution programs. It contains a discussion of agency missions and mandates, Federal personnel and facilities, program descriptions, and a listing of all Federal ocean pollution research, development, and monitoring projects including project descriptions and fiscal year funding levels.

**9418 (PB—89-104806/XAB) Review of the drinking water health criteria document for styrene. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 19 Jul 1988. 9p. (SAB/EHC—88/039). NTIS, PC A02/MF A01.

See also PB—86-118056.

The Drinking Water Subcommittee completed its review of the document. The Subcommittee made the following conclusions and recommendations: there is insufficient evidence to justify the reclassification of styrene to EPA's category B2 and the Committee recommend continuation of the category C classification, the study by Quast et al should be discounted because it was less than a lifetime study and the metabolism in the dogs poorly understood, the rationale for choosing the study used to quantify the risk was unclear and needs to be more clearly articulated, all of the epidemiology findings should be included in the analysis, and the exposure section needs to be changed to more realistically reflect the existing situation.

**9419 (PB—89-105845/XAB) Drinking-Water-Criteria document for polychlorinated biphenyls(PCBs). 1987 review of the draft final. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 Mar 1988. 12p. (SAB/EHC—88/019). NTIS, PC A03/MF A01.

See also PB—86-118312.

The Halogenated Organics Subcommittee of the Science Advisory Board's Environmental Health Committee completed its independent scientific review of the Draft Drinking-Water-Criteria Document for Polychlorinated Biphenyls (PCBs). The review was conducted in Washington, D.C. November 19-20, 1987. The major recommendation of the Subcommittee was that the U.S. Environmental Protection Agency explore whether the available data on PCB congeners can be developed on a scale of toxicity similar to the toxicity equivalency factor that the Agency had already prepared for dioxins. The efforts could potentially yield some scientifically interesting insights relating to uncertainties in the PCB data base even if it represents only an approximation in which data analysis and scientific judgment are combined. In general, the Subcommittee concluded that the document suffers from a failure to clearly identify its scientific objectives.

**9420 (PB—89-106298/XAB) Cape Cod Aquifer Management Project (CCAMP). Final report, August 1985-December 1987.** Zoto, G.A.; Gallagher, T. (Environmental Protection Agency, Boston, MA (USA). Region I). Sep 1988. 199p. (EPA—901/3-88/006). NTIS, PC A09/MF A01.

The Cape Cod Aquifer Management Project (CCAMP) was the first truly cooperative project of its kind in which a unique partnership was established between EPA, USGS, Mass. DEQE, and Cape Cod Planning (CCPEDC), but it was also charged with broadly exploring a topic of increased regional concern; integrated and resource-based ground water management among all levels of government. At a time when staff resources were limited, CCAMP provided an opportunity to explore a new approach to targeting environmental priorities based upon the degree of risk posed to the resource. The Project found certain ground water recharge areas were more threatened than others by particular land-use activities; these areas require priority attention within management programs at all levels of government. The land-use study illustrates the process which may be undertaken to identify these threatening activities and set these priorities. Numerous insightful recommendations put forth by the Institutions Committee outline how these priorities should be incorporated into regulatory programs.

**9421 (PB—89-109771/XAB) Municipal ground-water contamination in Massachusetts: the case for wellhead protection in humid regions.** Kaynor, E.R. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). May 1988. 219p. (PUB—158). NTIS, PC A10/MF A01.

Investigation of municipal ground-water contamination problems in Massachusetts reveals a wide array of approaches to reducing the problem. Generally, strategies of prevention (usually sociopolitical) were much more cost-effective than clean-up (usually engineering solutions). Degree of success of preventive strategies is difficult to predict because of individual case differences. Unresolved tensions between levels of government exist with respect to appropriate roles in reducing problems of ground water contamination. The most difficult institutional problem is the need for local action to solve local ground-water problems. Local agencies often lack both the impersonalism and breadth of expertise to solve such problems. Many of the friends and neighbors types of local-enforcement problems can be overcome by impersonal federal and state intervention. Massachusetts has achieved substantial success in controlling local ground-water contamination with imaginative state programs administered by generally dedicated environmental agencies.

**9422 (PB—89-110837/XAB) Opportunities to protect instream flows and wetland uses of water in South Carolina.** Truitt, R.C. (Denver Univ., CO (USA). Coll. of Law). Aug 1988. 56p. NTIS, PC A04/MF A01.

This report is one of a series of similar documents that provides a survey of State prerogatives and programs that may be used to protect the instream uses of water. Most of the opportunities for protecting instream flows are related to fish and wildlife habitat, although many other instream uses are considered, including hydroelectric power production, recreation, navigation, downstream delivery, and waste load assimilation. These documents illustrate methods to protect instream uses within the context of existing laws and regulations.

**9423 (PB—89-114300/XAB) Economic-impact analysis of effluent-limitations guidelines and standards for the organic chemicals, plastics, and synthetic-fibers industry.** (Abt Associates, Inc., Cambridge, MA (USA)). Sep 1987. 320p. (EPA—400/2-87/007). NTIS, PC A14/MF A01.

This report identifies and analyzes economic impacts that are likely to result from water-pollution-control regulations on the organic chemicals, plastics, and synthetic fibers (OCPSF) industry. The regulations included EPA effluent limitations and standards. The report supplements technical studies supporting the issuance of the OCPSF regulations by estimating the broader economic effects that might result from the application of various control methods and technologies. The primary economic-impact variables assessed include the costs of the contemplated regulations, and the potential for these regulations to cause plant closure, unemployment, reduc-

tions in profitability, shifts in the balance of trade, and anticompetitive effects on small business and new facilities.

9424 **(PB—89-117410/XAB) Superfund record of decision: (EPA Region 4): Zellwood groundwater contamination site, Zellwood, Florida. December 17, 1987. First remedial action. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 17 Dec 1987. 83p. (EPA/ROD/R—04-88/031). NTIS, PC A05/MF A01.

The 57-acre Zellwood site is located in the northwestern corner of Orange County, Florida, situated in a rural area, the site is occupied by four industries and an open field containing a marshy wetland area. Approximately 300 homes within a one-mile radius of the site depend on private wells as their sole source of potable water. Between 1963 and 1971, Drum Service Company of Florida, a drum recycling facility, operated waste-water disposal system without a regulatory permit, treating and disposing of generated waste waters in two onsite evaporation/percolation ponds. In 1980, the company eliminated the use of these ponds for waste disposal and in August 1981 initiated drainage and removal of contaminated sediments from the ponds. The selected remedial action for the site includes: excavation of soils and sediments with onsite incineration and testing of residuals to determine appropriate disposal; ground water pump and treatment with flushing of the treated ground water back through the abandoned drum area to facilitate cleanup of residual contamination; and a long-term groundwater monitoring program for private potable water wells. The estimated present-worth cost for the remedial action ranges from $41,264,244 to $61,908,244 with estimated present worth O&M of $13,543,244 (excluding ground-water treatment and remediation).

9425 **(PB—89-117436/XAB) Superfund record of decision (EPA Region 5): Eau Claire Municipal Well Field, Eau Claire County, Wisconsin. First remedial action, March 1988.** (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). 31 Mar 1988. 48p. (EPA/ROD/R—05-88/064). NTIS, PC A03/MF A01.

See also PB—85-249571.

The 500-acre Eau Claire Municipal Well Field (ECMWF) supplies drinking water to approximately 57,600 residents and numerous commercial establishments in the city of Eau Claire and Washington Township. Ground water from five municipal wells in the north well field is contaminated with VOCs. The contamination at the ECMWF site has been characterized as two separate plumes with the estimated volume of contamination at Plume 1 and 2 of 1.9 x $10^8$ $ft^3$ and 2.6 x $10^8$ $ft^3$, respectively. Concerned about the future use of the water supply, additional testing in September 1982 and January 1983 was conducted to identify the source and extent of VOC contamination. Several residential wells reported detectable levels of VOCs including, 1,1-dichloroethene concentrations in excess of the WDNR health advisory. The Eau Claire site was given a high Superfund NPL priority by WDNR due to the nature of the toxicity and persistence of the contaminants and the large population affected. The primary contaminants of concern affecting the ground water are VOCs and include: chloroform, DCE, dichloroethene, PCE, TCE, and trichloroethane. The selected remedial action for the site is proposed in the report. The estimated capital cost for the remedial action is $1,214,200 with annual O&M of $396,700.

## 53 Social And Economic Studies

*REFER ALSO TO CITATION(S) 7921*

## 5302 Assessment Of Energy Technologies

*REFER ALSO TO CITATION(S) 7904, 7905, 7906, 7907, 7908, 7909, 7910*

# 55 BIOMEDICAL SCIENCES, BASIC STUDIES

## 5501 Behavioral Biology

*REFER ALSO TO CITATION(S) 7595, 9485*

9426 **Heat loss regulation: role of appendages and torso in the deer mouse and the white rabbit.** Conley, K.E.; Porter, W.P. (Univ. of Wisconsin, Madison (USA)). *Journal of Comparative and Physiological Psychology, B;* **155**: 423-431(1985).

Thermal conductance was subdivided into the component conductances of the appendages and torso using a heat transfer analysis for the deer mouse, Peromyscus maniculatus, and the white rabbit, Oryctolagus cuniculus. The authors analysis was based on laboratory measurements of skin temperature and respiratory gas exchange made between air temperatures of 8 and 34°C for the deer mouse, and from published data for the white rabbit. Two series conductances to heat transfer for each appendage and torso were evaluated: (1) internal (h/sub in/), for blood flow and tissue conduction to the skin surface, and (2) external (h/sub ex/), for heat loss from the skin surface to the environment. These two series conductances were represented in a single, total conductance (h/sub tot/). The limit to h/sub tot/ was set by h/sub ex/ and was reached by the torso h/sub tot/ of both animals. The increase in torso h/sub tot/ observed with air temperature for the mouse suggests that a pilomotor change in fur depth occurred. A control of h/sub tot/ below the limit set by h/sub ex/ was achieved by the h/sub in/ of each appendage. Elevation of mouse thermal conductance (C) resulted from increases in feet, tail, and torso h/sub tot/. In contrast, the rabbit showed no change in torso h/sub tot/ between 5 and 30°C and ear h/sub tot/ exclusively increased C over these air temperatures. They suggest that the hyperthermia reported for the rabbit at 35°C resulted from C reaching the physical limit set by torso and near h/sub ex/. Thus the ear alone adjusted rabbit C, whereas the feet, tail, and the torso contributed to the adjustment of mouse C.

## 5502 Biochemistry

*REFER ALSO TO CITATION(S) 7534, 7543, 7590, 7596, 8608, 9219, 9499, 9516, 9576*

9427 **(AD-A—197495/5/XAB) Artificial membranes and liposomes for detection of neurotoxins. Contractor report, June 1984-May 1987.** Mansour, N.; Annau, Z.; Valdes, J.J. (Johns Hopkins Univ., Baltimore, MD (USA)). Apr 1988. 74p. NTIS, PC A04/MF A01.

The main objective of this contract is to isolate the essential components of the nerve membrane; i.e., the components that are the target(s) of chemical warfare agents (AChE, AChR and its ion channel), and to reinsert them in an artificial membrane in such a way that the state of the neurocomponents (proteins) can be constantly monitored with the same activity. The artificial membrane will be used to impart stability to the neuroproteins and to allow simple and sensitive monitoring of their response to the environmental toxic agents.

**9428 (AD-A—198423/6/XAB) Teratology studies of lewisite and sulfur mustard agents: effects of lewisite in rats and rabbits. Final report, 15 May 1983-28 February 1987.** Hackett, P.L.; Sasser, L.B.; Rommereim, R.L.; Cushing, J.A.; Buschbom, R.L. (Pacific Northwest Lab., Richland, WA (USA)). 31 Dec 1987. 71p. (PNL—6408). NTIS, PC A04/MF A01.

Lewisite, which is a prototype of one of two categories of vesicant war gases, functions by reacting with the sulfhydryl groups of proteins through its arsenic group. Since no information concerning the potential teratogenicity or developmental toxicity of lewisite was available, Pacific Northwest Laboratory, (PNL), under contract with USABRDL, conducted studies to evaluate maternal toxicity, intrauterine mortality, and developmental toxicity in rats and rabbits following the administration of this agent by intragastric intubation.

**9429 (AS/IB—9003454) Institute of Botany, Academia Sinica: Annual report, July 1987--June 1988.** (Academia Sinica, Taipei (Taiwan). Inst. of Botany). Jul 1988. 63p. NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE89003454/JAW.

This report describes the research programs and research results for this laboratory during a one year period. Abstracts of the 135 papers authored by the staff are included in this document. Forty-six speakers gave seminars at this institution. (TEM)

**9430 (DOE/ER/13339—4) Respiratory enzymes of {ital Thiobacillus ferrooxidans: Progress report, October 1987--November 1988.** Blake, R. II. (Meharry Medical Coll., Nashville (USA). Dept. of Biochemistry). 1988. Contract FG05-85ER13339. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003214/JAW.

Aim one is to purify and functionally characterize the acid-stable cytochrome c in crude extracts of {ital T. ferrooxidans} that catalyzes the Fe(II)-dependent reduction of rusticyanin. Efforts to purify this acid-stable cytochrome c have been hampered by two factors: (1) the protein behaves like a typical membrane-associated protein in that it appears to aggregate quite strongly with other membrane proteins in the preparation; and (2) the concentration of this cytochrome is never that great in crude extracts of {ital T. ferrooxidans}. The former property makes it difficult to disaggregate and purify the individual proteins while retaining the desired biological activity. The latter property dictates that the majority of the purification effort be directed toward actually growing a sufficient mass of the chemolithotrophic bacterium to supply ample quantities of crude extract. 2 figs.

**9431 (DOE/ER/13581—2) [Gene-enzyme relationships in somatic cells and their organismal derivates in higher plants]: Progress report.** Marshall, D.C. (Florida Univ., Gainesville (USA)). 1988. Contract AS04-76ER13581. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003374/JAW.

Our original recognition of L-arogenate, initially named pretyrosine, was in cyanobacteria. The proof of structure and chemistry of L-arogenate and related molecules such as spiro-arogenate have been carried out by collaborative efforts of other research groups. This collaboration began in 1977 and is going strong to the present day, leading to about one substantial publication per year. The major part of the comparative enzymology and enzyme characterization relevant to arogenate-utilizing enzymes in both microorganisms and higher plants has been done in our laboratories. Procedures for the new enzyme assays and for metabolite assay and isolation have of necessity been developed in out laboratories. We are aware of only two other groups that have prepared L-arogenate for enzyme assays. 32 refs., 3 figs., 2 tabs.

**9432 (DOE/ER/60545—2) DNA mismatch repair in monkey cells: Progress report, February 1, 1988--October 31, 1988.** Taylor, J.H. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1988. Contract FG05-87ER60545. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003054/JAW.

The goal of our research has been to try to understand what clues are used by a cell to determine which strand of the DNA duplex should be repaired when a mismatched DNA base pair is encountered. How can the cell distinguish the mistaken base from the correct base? There are several ways in which a mismatched base pair may arise and each of these simulations may have different features which could allow a discrimination between strands. Replication errors account for a large proportion of base pair mismatches in the cell. DNA polymerase $\alpha$ from HeLa cells has an in vitro error rate of 1 in 5,000, but cell extracts, probably containing the entire replication complex, have an error rate thirty fold lower. Presumably exonucleolytic proofreading corrects greater than 95% of errors made by DNA polymerase in mammals. It is easy to imagine several simple ways by which the replication complex which includes the proofreading exonuclease could distinguish the nascent strand containing the error. Between the in vitro error rate for the replication complex as a whole and the estimated spontaneous mutation rate there is at least a $10^5$ fold difference. Assuming this estimate is correct, an efficient post-replication repair system is operating. If this repair system is engaged very quickly after the passing of the replication fork, it may take advantage of the distinctions between old and new strands. New strands have nicks or gaps and have not yet been methylated by the cytosine methyl transferases. That both of these strand differences could provide discrimination mechanisms was first proposed for bacteria. In the case of the lagging strand the ends of the Okazaki fragments may be no more than 100-200 bases from any particular mismatch while on the leading strand the ends could be as far away as half the length of a replicon which could be as large as 20 kb. 1 ref.

**9433 (DOE/ER/60674—1) Base sequence effects on interactions of aromatic mutagens with DNA: Progress report for period March 1, 1988--November 30, 1988.** Geacintov, N.E. (New York Univ., NY (USA). Dept. of Chemistry). 1 Dec 1988. Contract FG02-88ER60674. 14p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004127/JAW.

The influence of base sequence on the structure of DNA, and the relationships between these effects and gene expression and regulation, are currently receiving wide attention. This project is focused on the effects of base composition and sequence, as well as on the thermodynamics of the interactions and binding of polynuclear aromatic hydrocarbon (PAH) mutagens with DNA. Such interactions between PHA molecules and cellular DNA are believed to be of critical importance in the expression of the mutagenic and tumorigenic potentials of these compounds. We have studied the interactions, especially noncovalent complex formation between the tetraols derived by the hydrolysis of the bay region diol epoxides of benzo(a)pyrene (BP), benz(a)anthracene (BA), 7,12-dimethylbenz(a)anthracene (DMBA), and 3-methylcholanthrene (3-MC) with single nucleotides, dinucleotides, oligonucleotides, synthetic polynucleotides, and native DNA. The formation of physical complexes depends on the base composition and the base sequence. The differences in the physical binding of these three different tetraol derivatives to native DNA are due to entropic rather than to enthalpic effects. In contrast to the BP and BA tetraols, the 3-MC tetraols do not form intercalation complexes with DNA; this effect is attributed to the steric bulk of the methyl and methylene bridge group which prevents the sandwiching of the 3-MC tetraol between the DNA base pairs. 6 refs., 3 figs., 2 tabs.

**9434 (DOE/ER/60688—1) [Characterization and modification of Phage T7 DNA polymerase for use in DNA sequencing]: Progress report.** Richardson, C. (Harvard Medical School, Boston, MA (USA)). 1988. Contract FG02-88ER60688. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004119/JAW.

The overall goal of this project is to understand in molecular terms the complex process by which a DNA polymerase and its accessory proteins faithfully copy a DNA template. Such knowledge will provide us with a reasonable approach to modifying these proteins by chemical and genetic procedures to increase their usefulness with DNA sequence analysis. We have chosen the DNA polymerase of bacteriophage T7 as a model system. During the next period we will focus on several topics. In order to improve the yield and purity of the T7 gene 5 protein/thioredoxin complex we hope to coexpress the genes for both proteins in the same cell and to improve the purification procedure. The physico-chemical studies proposed include crystallization of gene 5 protein. In order to

understand the molecular mechanism by which thioredoxin confers processivity on the polymerization reaction we will examine the interaction of the proteins with each other and with well defined primer-templates. A major effort will be directed to obtaining mutationally altered proteins that affect these interactions. Detailed studies will elucidate the precise mechanism by which active oxygen species specifically inactivate the exonuclease active site of gene 5 protein. A major effort will be directed toward determining the location of the metal binding site, the identity and location of the damaged residues, and the location of both the exonuclease and polymerase active sites. Such information will be used to genetically modify the gene 5 protein and thioredoxin to eliminate undesirable properties such as discrimination against nucleotide analogues and to enhance other properties. To identify a single amino acid residue essential for the exonuclease activity of the gene 5 protein. To date we have successfully inactivated the exonuclease activity by deleting 28 amino acids from the gene 5 protein.

9435 **(DOE/ER/60742—1) An immunochemical approach to the study of DNA damage and repair: Technical progress report for period August 1, 1987--July 31, 1988.** (Vermont Univ., Burlington (USA)). 1988. Contract FG02-88ER60742. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004123/JAW.

The overall objective for this project is to develop immunochemical methods to quantitate unique DNA base damages in x-irradiated DNA. Our approach has been to chemically synthesize modified nucleotides, conjugate them to protein carriers, and use the conjugates as immunogens in rabbits or to prepare monoclonal antibodies. We are studying damages that have been shown to be stable radiolysis products found in x-irradiated DNA and thus products that have potential biological consequence. Several thymine ring saturation or fragmentation products have been chosen as models for pyrimidine radiolysis products. For the present project period, we planned to use the characterized antibodies to quantitate DNA damage x-irradiated in vitro, to immunochemically characterize the antibody to dihydrothymine, and to develop new mono and polyclonal antibodies to model modified DNA bases. 41 refs.

9436 **(PB—89-851661/XAB) Single-cell-protein production in waste recovery. January 1978-December 1988 (Citations from the Life Sciences Collection data base). Report for January 1978-December 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 136p. NTIS PC N01/MF N01.

This bibliography contains citations concerning single-cell-protein production via waste recovery. This process biologically recycles effluents and is, therefore, a pollution-control mechanism as well as a source of protein production. Feeding stuffs and proteins produced using this method are used as food or feed additives and supplements. Various factors affecting the yield and the economic aspects of the process are discussed. (Contains 268 citations fully indexed and including a title list.)

9437 **(PNL-SA—16354) Anticancer chemotherapy.** Weller, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002371/JAW.

Despite troubled beginnings, anticancer chemotherapy has made significant contribution to the control of cancer in man, particularly within the last two decades. Early conceptual observations awakened the scientific community to the potentials of cancer chemotherapy. There are now more than 50 agents that are active in causing regression of clinical cancer. Chemotherapy's major conceptual contributions are two-fold. First, there is now proof that patients with overt metastatic disease can be cured, and second, to provide a strategy for control of occult metastases. In man, chemotherapy has resulted in normal life expectancy for some patients who have several types of metastatic cancers, including choriocarcinoma, Burkitt's lymphomas, Wilm's tumor, acute lymphocytic leukemia, Hodgkins disease, diffuse histiocytic lymphoma and others. Anticancer chemotherapy in Veterinary medicine has evolved from the use of single agents, which produce only limited remissions, to the concept of combination chemotherapy. Three basic principles underline the design of combination chemotherapy protocols; the fraction of tumor cell killed by one drug is independent of the fraction killed by another drug; drugs with different mechanisms of action should be chosen so that the antitumor effects will be additive; and since different classes of drugs have different toxicities the toxic effects will not be additive.

9438 **(UCRL—99620) Origin and heterogeneity of HDL subspecies.** Nichols, A.V.; Gong, E.L.; Blanche, P.J.; Forte, T.M.; Shore, V.G. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 13p. (CONF-8709381—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002662/JAW.

From Workshop on lipoprotein heterogeneity; Rockville, MD, USA (29 Sep 1987).

A major determinant of mature HDL particle size and apolar core content, in the absence of remodeling factors, is most likely the size and apolipoprotein content of the precursor particle. Depending on the number of apoA-I molecules per analog particle, the LCAT-induced transformation follows either a fusion pathway (for precursors with 2 apoA-I per particle) or a pathway (for precursors with more than 2 apoA-I per particle) that conserves the apolipoprotein number. According to our analog results, small nascent HDL probably serve as precursors to the major (apoA-I without apoA-II)-subpopulation in the size interval. Our studies with the large discoidal analog suggest that $HDL_2$ (apoA-I without apoA-II)-subpopulations probably originate from the large discoidal nascent HDL that contain a higher number of apolipoprotein molecules per particle than the small nascent HDL. Intermediate transformation products of the large discoidal analog, described in the present study, resemble deformable species found in human lymph and are characterized by a relatively high surface-to-core lipid ratio. Whether large discoidal precursors containing apoE transform in comparable manner but with eventual interchange of apoA-I for apoE (10,15) is under investigation in our laboratory. Likewise, detailed delineation of pathways whereby the (apoA-I with apoA-II)-HDL subpopulations are formed is yet to be accomplished. 23 refs., 6 figs., 2 tabs.

9439 **Fractal structure and the dynamics of aggregation of synthetic melanin in low pH aqueous solutions.** Huang, J.S.; Sung, J.; Eisner, M.; Moss, S.C.; Gallas, J. (Exxon Research and Engineering Co., Annandale, New Jersey 08801). *Journal of Chemical Physics;* **90**: No. 1, 25-29(1 Jan 1989).

We have used static and dynamic light scattering to study the dynamics of aggregation of synthetic melanin, an amorphous biopolymeric substance, in low pH aqueous solution. We have found that, depending on the final pH value of the solutions, there existed two regimes of the aggregation kinetics, one corresponding to diffusion limited aggregation (DLA), and the other corresponding to reaction limited aggregation (RLA). The precipitates formed in these two regimes can be characterized by fractal structures. We have found fractal dimensions of d/sub f/ = 1.8 for the DLA clusters and d/sub f/ = 2.2 for the RLA clusters. These results agree well with the proposed limits of the fractal dimensions of the gold aggregates formed in aqueous solutions by Weitz et al.

9440 **Reaction-intermediate analogues binding by ribulose bisphosphate carboxylase/oxygenase causes specific changes in proteolytic sensitivity: the amino-terminal residue of the large subunit is acetylated proline.** Mulligan, R.M.; Houtz, R.L.; Tolbert, N.E. (Stanford Univ., CA (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 5, 1513-1517(Mar 1988).

Trypsin rapidly inactivated the catalytic activities of spinach ribulose bisphosphate carboxylase/oxygenase but the stoichiometry of binding of the reaction-intermediate analogue carboxyarabinitol bisphosphate was only slightly reduced after proteolysis. Electrophoretic analysis indicated that several forms of the large subunit were generated during proteolysis but that the small subunit was resistant. Three tryptic peptides were isolated and characterized after digestion of the activated enzyme; the tryptic-sensitive sites were identified at Lys-8, Lys-14, and Lys-466 of the large subunit. Tryptic digestion of the enzyme complexed with the reaction-intermediate analogue released only two peptides by hydrolysis at Lys-8 and at Lys-14. The loss of susceptibility of Lys-466 to trypsin may be

the result of a conformational change that limits the accessibility of the carboxyl-terminal region after binding of the reaction-intermediate analogue. Analysis of the amino-terminal tryptic peptide by composition and fast atom bombardment mass spectrometry demonstrated that the actual amino-terminal residue is proline at position 3 of the DNA-deduced sequence and that this proline is blocked with an N-acetyl moiety. Thus, posttranslational processing of the chloroplast-encoded large subunit of the enzyme must occur to remove Met-1 and Ser-2 and to acetylate the amino terminus.

**9441 Looping out and deletion mechanism for the immunoglobulin heavy-chain class switch.** Jaeck, H.M.; McDowell, M.; Steinberg, C.M.; Wabl, M. (Univ. of California, San Francisco (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 5, 1581-1585(Mar 1988). Contract AC03-76SF01012.

In the mouse pre-B-cell line 18-81, cells can switch production in vitro from immunoglobulin $\mu$ chain to $\gamma$2b chain. The gene encoding the $\gamma$2b chain is created by a rearrangement of the $\mu$ gene. This rearrangement always takes place within a homolog. In cells with a $\gamma$2b gene, most of the time the gene segment encoding the constant region of the $\mu$ chain is deleted, but often the rearrangement leads to cells that produce no immunoglobulin, and all DNA sequences are retained. The latter result is due to an inversion. Inversions exclude the unequal sister chromatid exchange model of the heavy-chain class switch. Looping out is an intermediate step in the process of generating an inversion. These finding demonstrate that the switch rearrangement occurs by looping out and deletion.

**9442 Myeloperoxidase: a myeloid cell nuclear antigen with DNA-binding properties.** Murao, S.I.; Stevens, F.J.; Ito, A.; Huberman, E. (Argonne National Lab., IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 4, 1232-1236(Feb 1988). Contract W-31-109-ENG-38.

An antigen histochemically localized in the nuclei and cytoplasmic granules of normal and leukemic human myeloid cells has been identified as myeloperoxidase. The localization and amount of the enzyme was determined by using a murine monoclonal antibody designated H-43-5 raised against nuclear proteins derived from human promyelocytic HL-60 leukemia cells. The highest amount of nuclear MPO was found in granulocytes; less than half of this amount was detected in nuclei from HL-60 cells. MPO from HL-60 cells was purified by immunoaffinity chromatography, fractionated into three components (forms I, II, and III) by CM-cellulose chromatography, and measured using radioimmunoassay. Chromatography of these MPO forms on DNA-Sepharose columns confirmed that all three forms of MPO were tightly bound to DNA with apparent relative affinities in the order of form III > form II > form I. The affinity of MPO form III for DNA was sufficient to enable the formation and elution of DNA-MPO complexes during size-exclusion chromatography at high ionic strength and neutral pH. This form of MPO was also able to shield DNA from strand scission induced by active oxygen species generated by xanthine oxidase acting aerobically on xanthine. These data suggest that intranuclear MPO may help to protect DNA against damage resulting from oxygen radicals produced during myeloid cell maturation and function.

**9443 Lignans of Myristica otoba.** Nemethy, E.K.; Lago, R.; Hawkins, D.; Calvin, M. (Univ. of California, Berkeley (USA)). *Phytochemistry;* **25**: No. 4, 959-960(1986). Contract AC03-76SF00098.

From the neutral fraction of the oil of Myristica otoba fruits the authors isolated a series of seven aryltetralin lignans. The minor constituents galbulin and galcatin have been isolated from other sources but have not been identified as components of M. otoba oil. Isogalcatin has also been identified as a component of M. otoba. The lignan otobain [7,8-methylenedioxy)-2,3-dimethyl-1-(3′,4′-methylenedioxyphenyl)-tetralin] has been isolated from this source previously, and its structure was elucidated. The absolute configuration of otobain has been suggested based on NMR and ORD spectroscopy. They have not been able to detect the presence of otobain at the 0.5% level in their sample of the oil; the two major aryltetralin lignans they have identified are 1 and 2, comprising 37 and 12% of the neutral fraction, respectively.

**9444 Visualization of drug-nucleic acid interactions at atomic resolution. VII. Structure of an ethidium/dinucleoside monophosphate crystalline complex, ethidium: uridylyl(3′-5′)adenosine.** Jain, S.C.; Sobell, H.M. (Univ. of Rochester, NY (USA)). *Journal of Biomolecular Structure and Dynamics;* **1**: No. 5, 1161-1177(1984).

Ethidium forms a crystalline complex with the dinucleoside monophosphate, uridylyl (3′-5′) adenosine (UpA). The complex crystallizes in the monoclinic space group $P2_1$ with unit cell dimensions, a = 13.704 A, b = 31.674 A, c = 15.131 A, $\beta$ = 113.8°. This light atom structure has been solved to atomic resolution and refined by full matrix least squares to a residual of 0.12, using 3034 observed reflections. The asymmetric unit consists of two ethidium molecules, two UpA molecules and 19 solvent molecules, a total of 145 non-hydrogen atoms. The two UPa molecules are hydrogen-bonded together by Watson-Crick base pairing. Base-pairs in this duplex are separated by 6.7 A; this reflects intercalative binding by one of the ethidium molecules. The other ethidium molecule stacks on either side of the intercalated base-paired dinucleoside monophosphate, being related by a unit cell translation along the a axis. The conformation of the sugar-phosphate backbone accompanying intercalation has been accurately determined in this analysis, and contains the mixed sugar-puckering pattern: C3′ endo (3′-5′) C2′ endo. This same structural feature has been observed in the ethidium-iodoUpA and ethidium-iodoCpG complexes, and exists in two additional structures containing ethidium-CpG. Taken together, these studies confirm the authors earlier sugar-puckering assignments and demonstrate that iodine covalently bound to the C5 position on uridine or cytosine does not alter the basic sugar-phosphate geometry or the mode of ethidium intercalation in these model studies. The authors have proposed this stereochemistry to explain the intercalation of ethidium into both DNA and into double-helical RNA. 15 references, 10 figures, 2 tables.

**9445 Electron crystallographic studies of DNA.** Downing, K.H. (Lawrence Berkeley Lab., CA (USA)). *Ultramicroscopy;* **13**: 35-46(1984). Contract AC03-76SF00098.

The conformation of DNA in thin, platelet crystals is being studied by electron microscopy and diffraction, and by other techniques including circular dichroism spectroscopy. Specimens are prepared in the frozen-hydrated state for the electron microscope. Electron diffraction patterns from the crystals extend to 3.5 A, and lattice images with resolution to 6.5 A have been obtained. Electron diffraction patterns from fibers in the same preparations show a stacking distance between base pairs which is larger than in most DNA conformations. The data so far available can be interpreted to indicate that the DNA in the crystals is in a conformation which has not previously been reported and which is in the B family, unwound to have 12 base pairs per turn. Model calculations have been performed which support this interpretation and which show that a three-dimensional reconstruction, with even very limited data, could confirm the helix parameters.

## 5503 Cytology

*REFER ALSO TO CITATION(S) 9315, 9429*

**9446 (AD-A—198960/7/XAB) Development of in vitro isolated perfused porcine skin flaps for study of percutaneous absorption of xenobiotics. Annual report, 30 September 1985-29 September 1986.** Riviere, J.E.; Carver, M.P.; Monteiro-Riviere, N.A.; Bowman, K.F. (North Carolina State Univ., Raleigh (USA). Lab. of Toxicokinetics). 1 Nov 1986. 26p. NTIS, PC A03/MF A01.

Interspecies comparisons of cutaneous anatomy and physiology suggest that the weanling pig is a suitable surrogate for human skin; however, very few investigations of percutaneous absorption phenomena have been conducted in pigs. This study examined the radiolabel excretion patterns after intravenous (IV) and topical administration of six $^{14}$C-labeled compounds in weanling Yorkshire sows. These data were required as a baseline to compare xenobiotic absorption in the isolated perfused procine skin flap (IPPSF) fully described in the first Annual Report (Riviere, J. E., Bowman, K. F., and Monteiro-Riviere, N. A., Development of In Vitro Isolated Perfused Porcine Skin Flaps for Study of Percutaneous Absorption

of Xenobiotics, USAMRDC, DAMD17-84-C-4103, November 1, 1986).

## 5504 Genetics

*REFER ALSO TO CITATION(S) 7201, 7590, 9429, 9461, 9462*

9447 **(AD-A—198994/6/XAB) Biopolymers: protein and nucleic acids. Annual report, 15 September 1987-14 September 1988.** Richards, J.H.; Abelson, J.N.; Dervan, P.B.; Hood, L.H.; Simon, M.I. (California Inst. of Tech., Pasadena (USA). Dept. of Chemistry). 15 Sep 1988. 16p. NTIS, PC A03/MF A01.

The work focuses on learning the principles that govern interactions between proteins and nucleic acids, both DNA and RNA (specifically tRNA). With these principles as guides peptides (of about 50 amino acids) that bind to specific regions of DNA are being synthesized. Various reactive functionalities are being attached to the synthetic peptides to generate reagents that cleave DNA specifically at the site to which the peptide binds. The work also involves biophysical studies of the protein/nucleic acid complexes in order to expand our understanding of the principles of protein binding to nucleic acids. Development of improved procedures for the chemical synthesis of peptides forms another important aspect of the program.

9448 **Amino acid substitutions in inherited albumin variants from Amerindian and Japanese populations.** Takahashi, N.; Takahashi, Y.; Isobe, T.; Putnam, F.W.; Fujita, M.; Satoh, C.; Neel, J.V. (Indiana Univ., Bloomington (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 22, 8001-8005(Nov 1987). Contract AC02-82ER60089.

The authors report an effort to determine the basis for the altered migration of seven inherited albumin variants detected by one-dimensional electrophoresis in population surveys involving tribal Amerindians and Japanese children. An amino acid substitution has thus far been determined for four of the variants. The randomness in the albumin polypeptide of these and the other sixteen independently ascertained amino acid substitutions of albumin and proalbumin thus far established was analyzed; the clustering of eight of these at two positions in the six-amino acid propeptide sequence seems noteworthy. By comparison with other proteins studied by electrophoresis, albumin exhibits average variability. It is a paradox that individuals who, for genetic reasons, lack albumin exhibit no obvious ill effects; yet, electrophoretic variants of albumin are no more numerous than are variants of proteins, the absence of which results in severe disease.

## 5505 Metabolism

*REFER ALSO TO CITATION(S) 7201, 7611, 9538, 9549*

9449 (KFK-PEF—35-Vol.1, pp 219-229) **Effects of nitrate, ammonium and light on enzymes of nitrogen metabolism in Scots pine (Pinus sylvestris L.) seedlings.** Kasemir, H.; Flaig, H.; Hecht, U.; Klein, E.; Lettgen, W.; Vollbrecht, P. (Freiburg Univ. (Germany, F.R.). Inst. fuer Biologie 2). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

This paper presents results forming part of an investigation into ammonium toxicity in conifer seedlings. Changes in the levels of glutamine synthetase (GS), glutamate synthase (GOGAT) and glutamate dehydrogenase (GDH), enzymes concerned with the metabolism of ammonium were investigated in Scots Pine (Pinus sylvestris L.) seedlings. It could be shown that both the form in which nitrogen was supplied (NH/sub 4//sup +/, NO/sub 3//sup -/) and the white light fluence rate had a regulatory effect on ammonium assimilation. Application of ammonium (15 mM) unter low light conditions (30 mW/sup -2/) led to an inhibition of the GS/GOGAT system and the GDH isoenzyme responsible for ammonium-detoxification in the plastids (NAPD-dependent). When the seedlings were transferred to high light (100 Wm/sup -2/) after 10 days, the supply with ammonium resulted in an increase in the activity of the GS/GOGAT system and the NADP-dependent GDH. Supplying nitrate resulted in the case of GS and Fd-GOGAT in only a slight change, in the case of NADP-GDH and NADH-GOGAT, however, in a considerable rise in activity. In contrast to the situation for ammonium, a toxic or damaging effect of nitrate could not be found at the level of the enzymes studied here.

## 5506 Medicine

*REFER ALSO TO CITATION(S) 9443, 9458, 9597*

9450 **(AD-A—198414/5/XAB) Radioisotope imaging of brain tumors in two rhesus monkeys. Final report.** Fanton, J.W.; Cordts, R.E.; Harris, R.K.; Romo, D.; Wood, D.H. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Apr 1988. 5p. (USAFSAM-JA—86-27). NTIS, PC A02/MF A01.

Pub. in Laboratory Animal Science, Vol. 38, No. 2, 214-217(Apr 1988). Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Two geriatic male rhesus monkeys were used for the radioisotope imaging in this research. Discussion of the radionuclide, materials, and method used to accomplish the neurologic examination and the results obtained, both during the procedure and confirmation of the results by necropsies were accompanied by color photos of scan images. Results were that the nuclear images provided accurate images of intracranial neoplasia.

9451 **(BNL—41981) Radiopharmaceuticals in PET, progress and promise.** Wolf, A.P.; Fowler, J.S. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-8811103—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002941/JAW.

From 4. Asia and Oceania congress of nuclear medicine; Taipei, Taiwan (1 Nov 1988).

It is the intention of this presentation to focus on the current state of radiopharmaceuticals for PET and where this is leading us. PET radiopharmaceuticals can be broken down into perhaps seven categories at present with each being applicable to a different aspect of human biochemistry. These are: metabolic probes, neurochemical probes, enzyme probes, ion channel blockers, blood flow agents, ethical drugs and other positron emitters. 7 refs.

9452 **(PB—89-851711/XAB) Nuclear magnetic resonance coils. January 1975-November 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 73p. NTIS PC N01/MF N01.

Supersedes PB—87-858908.

This bibliography contains citations concerning the coils used to produce images in Nuclear Magnetic Resonance Imaging. Placement of NMR probes and coils in resonance devices is described. Probe construction, tuning, and spinning are discussed. Methods of reducing ringing in NMR probes are explored. Probe and coil design for high-pressure, high-temperature, cryogenic, and variable-temperature applications is considered. (This updated bibliography contains 122 citations, 28 of which are new entries to the previous edition.)

9453 **(PNL-SA—16356) Mammary tumors.** Weller, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002367/JAW.

Mammary neoplasia is one of the more common malignancies affecting domestic species. Despite their importance, they are often over- diagnosed, undertreated and subject to several misconceptions propagated by veterinarians and pet owners alike. Mammary neoplasia is the most frequent tumor type encountered in the female accounting for almost half of all malignancies reported. The canine has the highest incidence of mammary tumors of all domestic species. In the dog, about 65 percent of mammary tumors are

benign mixed tumors, and 25 percent are carcinomas. The rest are adenomas, myoepitheliomas, and malignant mixed tumors. The age distribution of mammary tumors closely follows the age distribution of most tumors in the dog. Mammary tumors are rare in dogs 2 years old, but incidence begins to increase sharply at approximately 6 years of age. Median age at diagnosis is about 10 years. No breed predilection has been consistently reported.

9454 **(PNL-SA—16360) Biological response modifiers.** Weller, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002365/JAW.

Much of what used to be called immunotherapy is now included in the term biological response modifiers. Biological response modifiers (BRMs) are those agents or approaches that modify the relationship between the tumor and host by modifying the host's biological response to tumor cells with resultant therapeutic effects. Most of the early work with BRMs centered around observations of spontaneous tumor regression and the association of tumor regression with concurrent bacterial infections. The BRM can modify the host response by increasing the host's antitumor responses through augmentation and/or restoration of effector mechanisms or mediators of the host's defense or decrease the deleterious component by the host's reaction, increasing the host's defenses by the administration of natural biologics (or the synthetic derivatives thereof) as effectors or mediators of an antitumor response, augmenting the host's response to modified tumor cells or vaccines, which might stimulate a greater response by the host or increase tumor-cell sensitivity to an existing response, decreasing the transformation and/or increase differentiation (maturation) of tumor cells, or increasing the ability of the host to tolerate damage by cytotoxic modalities of cancer treatment.

9455 **(AD-A—198646/2/XAB) Medical prevention and protection against chemical weapons (Chapter Three).** Ziqian, O.; Tingzhi, W. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 13 Jul 1988. Trans. of Fang Hua Yi Xue (China), 96-136 (Nov 1985). (FTD-ID(RS)T—0215-88). 97p. NTIS, PC A05/MF A01.

In order to avoid or reduce injuries caused to the front and rear when an enemy conducts chemical attacks, not only the military must do the protection work well, but local cities, especially important cities, must also not be ignored. Doing the protection work well has important significances in preserving combat capabilities of troops, completing combat missions, ensuring safety of people's lives and maintaining normal production and labor order. Although chemical weapons possess greater casualty-inflicting and destruction effects, they can be protected against and are curable. There are primarily three areas of work to be done well in the protection against chemical weapons: toxicant detection and examination; personal protection and group protection; and washing and sterilizing.

9456 **Protein comparison and classification: a differential geometric approach.** Rackovsky, S.; Goldstein, D.A. (Univ. of Rochester, NY (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 3, 777-781(Feb 1988). Contract FG02-85ER60281.

A method is proposed for rapidly, quantitatively comparing protein structures of arbitrary sizes, based on the differential geometric representation. The method is applied to a group of 22 protein x-ray structures, and the resulting network of closest relationships is delineated. Several well-known fold types are automatically detected as groupings of related structures, even when the constituent proteins are of different lengths. A complete gradation of types is shown to be detected, ranging from all-helical top all-$\beta$-structure proteins. A relationship among functionally similar proteins is shown in several cases, even where their three-dimensional structures differ. It is suggested that the positions of proteins within the network of relationships correspond with their folding mechanisms.

## 5507 Microbiology

*REFER ALSO TO CITATION(S) 9387, 9388, 9431*

## 5509 Pathology

*REFER ALSO TO CITATION(S) 7893, 9176, 9226, 9365, 9427, 9517, 9518, 9519, 9553, 9554, 9555, 9557, 9561, 9563, 9565, 9568, 9605*

9457 **(AD-A—198097/8/XAB) Toxic Hazards Research Unit annual report: 1987. Report No. 24, October 1986-October 1987.** Houston, W.E.; Kutzman, R.S. (Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA)). Mar 1988. 208p. NTIS, PC A10/MF A01.

The report was prepared as a review of the activities of the Toxic Hazards Research Unit for the period of October 1986 through September 1987. Research activities focused on toxicity evaluations of aerospace and naval chemicals and materials to include hydraulic fluids, lubricating oils, ground-water contaminants, chemical-defense simulants, and binary-agent components. Physiologically based pharmacokinetic/pharmacodynamic modeling was developed and provides methods for simulating the toxicological effects of selected chemicals, including models for chemical carcinogenesis. The completion and utilization of the General Toxicology Laboratory within the THRU has resulted in the completion of an increased number of acute and repeated treatment studies, and additional subchronic studies are planned. The objectives of this research program are to identify and characterize the toxic effects of chemicals, compounds, and materials that are of operational interest and concern to the Air Force and Navy. This coordinated USAF-USN program generates scientific information from which simulation and predictive models, experimental design,and risk assessment criteria can be developed.

9458 **(AD-A—199017/5/XAB) Research pathology and special techniques. Annual report, 15 May 1987-14 May 1988.** Hall, W.C. (Pathology Associates, Inc., Ijamsville, MD (USA)). 31 May 1988. 26p. NTIS, PC A03/MF A01.

The mission of the research at USAMRIID is multifaceted and has several major thrusts: 1) drug development for treatment and prevention of infection by potential BW agents, 2) toxin research leading to the discovery of methods to provide defense against a wide variety of toxins, and 3) rapid identification an diagnosis of disease agents, metabolites, and analogs in clinical specimens and collector samples. Immunoperoxidase procedures using the ABC and/or PAP methods have been completely developed for 8 viruses (Hantaan, yellow fever, Dengue 1 and 1-4 with a common antibody), VEE, Marburg, Ebola, Junin, and MHV) and fibrinogen, partially established for 3 others (RVF, Punta Toro, and Machupo) and were unsuccessful for LCM, Q fever and saxitoxin. A training program has been established and six persons have been trained in immunoperoxidase procedures. Collaboration with other Institute investigators for various Divisions has taken place on a routine basis. An adequate bank of resource materials has been archived to include animal tissues containing virus, adequate reagents, and aliquots of antibodies. Tissue preparation for immunoelectron microscopy has begun in collaboration with Drs. White and Downs.

9459 **(PB—88-870340/XAB) Toxicity of selenium. January 1970-October 1988 (Citations from the NTIS data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 128p. NTIS PC N01/MF N01.

Supersedes PB—86-852266.

This bibliography contains citations concerning the toxicity, carcinogenicity, environmental pollution, and other hazards and adverse effects of selenium. These aspects of selenium are dealt with in relation to aquatic and terrestrial flora and fauna, including man. (This updated bibliography contains 160 citations, 29 of which are new entries to the previous edition.)

9460 **(PB—88-934400/XAB) RTECS (Registry of Toxic Effects Chemical Substances) regulatory subfile. Regulations, recommendations, and assessments (for microcomputers). Data file.** (Robert A. Taft Labs., Cincinnati, OH (USA)). 1985. vp. NTIS Subscription.

The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC/XT or AT microcomputer using DOS 3.1. The diskettes are in the dBase III Plus format. Available on subscription, North American Continent price $1500.00/year; individual issue $375.00; all others write for quote. Issued quarterly.

Regulations, Recommendations and Assessments Extracted from RTECS -- Contains 4277 chemical substances which must have had one or more of the following data lines: OSHA standards, MSHA standards, DOT shipping regulations, NIOSH recommendations, ACGIH TLV, IARC assessments indicating positive or suspected carcinogenic activity in animals and/or man, and NTP positive carcinogenesis test results. Substances are listed in alphabetical order by the prime entry name. The data file can be searched by RTECS accession number, CAS Registry Number, or fragment of name or synonym. Diskettes were created in dBase III Plus format, using DOS 3.1 and are in the Backup format.

9461 **(PB—89-109664/XAB) Genetic-activity profiles and pattern recognition in test-battery selection (journal version).** Waters, M.D.; Stack, H.F.; Rabinowitz, J.R.; Garrett, N.E. (Environmental Health Research and Testing, Inc., Research Triangle Park, NC (USA)). 1988. 22p. NTIS, PC A03/MF A01.

Pub. in Mutation Research, Vol. 205, 119-138(1988).

Computer-generated genetic activity profiles and pairwise matching procedures may aid in the selection of the most-appropriate short-term bioassays to be used in test batteries for the evaluation of the genotoxicity of a given chemical or group of chemicals. Selection of test batteries would be based on a quantitative comparative assessment of the past performance of similar tests applied to other chemicals of the same structural group. Application of the method should further our understanding of the relationships between chemical properties and genotoxic responses obtained in short-term bioassays, and also may contribute to our knowledge of the mechanisms of complex processes such as carcinogenesis. The approach to battery selection should be augmented by careful consideration of established principles of genetic toxicity testing; that is, a chemical should be evaluated in a battery of tests representing the full range of relevant genetic endpoints.

9462 **(PB—89-116339/XAB) Environmental mutagenesis and carcinogenesis.** Notani, N.K.; Chauhan, P.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 215p. NTIS, PC E08/MF A01.

A special publication presents a collection of 18 research papers and research overviews concerning recent findings in environmental causes of mutagenesis and carcinogenesis transportations at the biological cellular and pathological tissue levels. Topics include experiments in genetic toxicology, in vitro and in vivo genotoxicity, mutations induced by chemical and radiation, methodology for assessing DNA mutations and their repair, case studies, risk assessment, and cancer prevention. Experimental data and graphs are included, and literature citations are appended to each paper.

## 5510 Physiological Systems

*REFER ALSO TO CITATION(S) 9548*

9463 **(PB—88-247846/XAB) Mucociliary transport and particle clearance in the human tracheobronchial tree.** Yu, C.P.; Hu, J.P.; Leikauf, G.; Spektor, D.; Lippmann, M. (State Univ. of New York, Buffalo (USA). Faculty of Engineering and Applied Sciences). 1981. 6p. NTIS, PC A02/MF A01.

A compartmental model to describe mucociliary transport and particle clearance in the tracheobronchial trees was described. A method was proposed for determining the mucociliary transport rate as a function of the airway depth from the retention curve directly. Each airway generation was represented by an escalator. For Weibel's lung model there were 17 airway generations in the tracheobronchial tree. The subject performed a series of respiratory mechanical function tests prior to exposure to a monodisperse ferric-oxide aerosol tagged with technetium-99. The model was simple and appeared to describe the physical process well.

## 5520 Public Health

*REFER ALSO TO CITATION(S) 7213, 7254, 7288, 7289, 7291, 7340, 7886, 7888, 7889, 7890, 7891, 7892, 7897, 7953, 8004, 9154, 9173, 9178, 9179, 9180, 9182, 9183, 9184, 9187, 9189, 9190, 9191, 9193, 9194, 9195, 9196, 9197, 9198, 9199, 9203, 9208, 9209, 9210, 9211, 9212, 9214, 9215, 9216, 9221, 9222, 9223, 9225, 9227, 9229, 9230, 9231, 9232, 9233, 9234, 9235, 9238, 9239, 9240, 9245, 9247, 9248, 9249, 9250, 9251, 9252, 9253, 9254, 9274, 9285, 9349, 9364, 9371, 9387, 9388, 9569, 9604*

9464 **(AD-A—198158/8/XAB) Navy Occupational Health Information Management System (NOHIMS). Users' reference manual. COSTAR (Computer-Stored Ambulatory Record System). Operators guide.** (Navy Regional Data Automation Center, Washington, DC (USA)). May 1987. 179p. NTIS, PC A09/MF A01.

For magnetic tape, see AD-A198 157.

The objective of the Navy Occupational Health Information Management System (NOHIMS) is to provide an information system that will coordinate the components of the Navy's occupational health program in order to meet the requirements of the Occupational Safety and Health Act of 1970. NOHIMS consists of two subsystems: (1) an industrial-information component and (2) a medical-information component. The industrial-information component performs all of the functions required to identify individuals at risk and to insure that they are examined periodically. Therefore, the industrial subsystem contains personnel and environmental data. The industrial-information component of NOHIMS has been designed and developed by the Naval Health Research Center. The Computer Stored Ambulatory Record System (COSTAR) is one of the two subsystems comprising NOHIMS. COSTAR is a medical information and communication system with software developed by Massachusetts General Hospital. COSTAR itself is a public-domain software package which has been modified for use in Navy Occupational Medicine, the major modification being the elimination of accounts receivable and billing functions. COSTAR collects demographic and medical patient data both current and historical. Features of COSTAR include a variety of displays of a patient's medical records and the printing of various reports derived from individual patient records.

9465 **(AD-A—198160/4/XAB) Navy Occupational Health Information Management System (NOHIMS). System/Functional Manager's guide.** (Navy Regional Data Automation Center, Washington, DC (USA)). Apr 1987. 154p. NTIS, PC A08/MF A01.

For magnetic tape, see AD-A198 157.

This guide is intended to provide the necessary guidance to successfully manage the NAVMED Navy Occupational Health Information Management System (NOHIMS) at NAVMED sites and the NAVSEA Occupational Safety and Health Record Keeping System (OSHRKS) at NAVSEA sites. Outlines procedures to manage system operations, procedures to resolve hardware, software and communications problems, and procedures outside the realm of system operations that are required for a successful system. This guide is intended for the System and Functional Managers use. The System Manager is the individual designated to provide overall ADP management to the entire local configuration. Usually responsible for file backup, daily operations of the CPU, security, supplies, equipment, operating software and technical ADP guidance to the local functional users.

9466 **(AD-A—198164/6/XAB) Naval Sea Systems Command occupational safety and health record-keeping system. Hazardous Materials Control Module. Program maintenance manual.** (Navy Regional Data Automation Center, Washington, DC (USA)). Jun 1987. 89p. NTIS, PC A05/MF A01.

For magnetic tape, see AD-A198 157.

Since August 1984, the MITRE Corporation has been supporting the Naval Sea Systems Command (NAVSEA) and the

Naval Medical Command (NAVMEDCOM) in their joint efforts to enhance the Navy Occupational Health Information Management System (NOHIMS). The goal of the enhancement effort was to create a comprehensive occupational health and safety system for Navy industrial facilities by expanding upon the original NOHIMS functions and adding modules for hazard deficiency abatement, hazardous-material control, injury claims and compensation, and safety and health training. To meet this goal, MITRE developed an enhanced industrial subsystem, referred to as the Occupational Safety and Health Record Keeping System (OSHRKS), using a prototyping approach and a public-domain data base-management software package, the Veterans Administration's (VA's) FileManager (FileMan).

9467 **(AD-A—198165/3/XAB) Navy Occupational Health Information Management System (NOHIMS). Hazardous Materials Control Module. Operators' guide.** Fiddleman, R.H.; Miller, K.D. (Navy Regional Data Automation Center, Washington, DC (USA)). 16 Jan 1987. 57p. NTIS, PC A04/MF A01.

For magnetic tape, see AD-A198 157.

This guide explains how a user interacts with the Hazardous Materials Control (HMC) module of the Naval Medical Command's (NAVMED) Navy Occupational Health Information Management System (NOHIMS). The Industrial Hygiene (IH) office can use the HMC module to inform employees of health and safety hazards in the workplace and to track the movement of hazardous materials through the facility. The module performs these functions by maintaining health and safety data on hazardous materials used in the facility, and by tracking who requests information about any hazardous material.

9468 **(AD-A—198170/3/XAB) Navy Occupational Health Information Management System (NOHIMS). Hazardous Materials Control Module. Users' manual.** Fiddleman, R.H.; Miller, K.D. (Navy Regional Data Automation Center, Washington, DC (USA)). 16 Jan 1987. 65p. NTIS, PC A04/MF A01.

For magnetic tape, see AD-A198 157.

The Hazardous Materials Control Module (HMC) is one module of four for the Industrial Health component. The HMC module was designed to inform employees of health and safety hazards in the workplace and to track the movement of hazardous materials through the facility. The module performs these functions by maintaining health and safety data on hazardous materials used in the facility, and by tracking who requests information about any hazardous materials. The HMC module gets its information from two sources. The first one is the Hazardous Materials Information System (HMIS), this is a national system that is used by the Department of Defense. It is loaded on to the system via tapes that contain all safety, health and transportation information about a particular product. The second is Material Safety Data Sheets (MSDS) that are procured by a particular site. This information is manually entered into their own personal system, which they give a site specific sequential number.

9469 **(PB—89-101281/XAB) Field survey, Young Aniline Works, Inc., Baltimore, Maryland, February 22, 1973.** Johnson, W.M.; Parnes, W.D.; Shuler, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1973. 21p. (IWS—093.16). NTIS, PC A03/MF A01.

An industrial hygiene survey and preliminary epidemiological investigation of the Young Aniline Works, Inc., Baltimore, Maryland, was conducted on February 22, 1973, as part of the NIOSH industrywide study of the producers and users of benzidine and its salts. A detailed description is given of the handling of benzidine sulfate slurry in the production of dyes. Industrial-hygiene measures and medical surveillance for bladder cancer, in effect at the time of the survey, are described. Worker exposure to benzidine sulfate slurry was observed in the drum unloading and benzidine mixing and charging area, and engineering controls in the area were grossly inadequate. Several exposure problems were observed in the use of personal protective equipment and work clothing in addition to work-procedure difficulties in the unloading and mixing operation. Recommendations are made to reduce worker exposures and increase occupational health protection.

9470 **(PB—89-107767/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on Occupational Safety and Health Administration's proposed rule on electrical safety-related work practices.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 9 Aug 1988. 11p. NTIS, PC A03/MF A01.

The testimony summarized information contained in the Proposed Rule on Electrical Safety-Related Work Practices as put forth by OSHA, specifically expanding for clarification the sections dealing with the definition, training, and work practices. NIOSH believes that every worker should be trained to identify and respond appropriately to electrical hazards in the workplace. NIOSH also suggests that the training include a written training program administered by a qualified person. In the selection and use of work practices, NIOSH would recommend that this section also include a specific requirement for the inspect of permanently installed electrical equipment, wiring, and connections, similar to that provided in the section dealing with portable electrical equipment. Modifications of the lockout and tagging procedures are suggested. Regarding definitions, NIOSH suggests that the definition for a qualified person be modified to more appropriately apply to the large range of job classifications covered by Part-S. For the buddy system, a NIOSH definition is offered which stresses the requirement that at least two qualified persons be in the immediate area of work being performed, both of whom have current certifications in cardiopulmonary resuscitation.

9471 **(PB—89-109193/XAB) National Occupational Exposure Survey (NOES). Volume 1. Survey manual.** Seta, J.A.; Sundin, D.S.; Pedersen, D.H. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Mar 1988. 242p. (DHHS/PUB/NIOSH—88-106). NTIS, PC A11/MF A01.

See also PB—84-211135.

Instructions provided to the National Occupational Exposure Survey (NOES) surveyors were compiled to serve as a reference tool for those engaged in the evaluation of the survey data and procedures and as a guide to others engaged in large-scale data-gathering activities, collecting information on potential exposure agents. NOES was designed to gather and provide data needed to describe potential exposures agents and profile health and safety programs in workplaces in the United States. Trained surveyors conducted on-site visits to each facility for the purpose of administering questionnaires and viewing the work sites. A history of the survey was provided. Instructions were included for the preparing of the various forms used in the survey portion of this data-gathering process. Training of those engaged in survey taking was described, and terms used were defined.

9472 **Using mathematical models to under the the AIDS epidemic.** Hyman, J.M.; Stanley, E.A. (Los Alamos National Lab., NM (USA)). *Mathematical Biosciences;* **90**: No. 1-2, 415-473(Jul-Aug 1988). Contract W-7405-ENG-36.

The most urgent public-health problem today is to devise effective strategies to minimize the destruction caused by the AIDS epidemic. This complex problem will involve medical advances and new public-health and education initiatives. Mathematical models based on the underlying transmission mechanisms of the AIDS virus can help the medical/scientific community understand and anticipate its spread in different populations and evaluate the potential effectiveness of different approaches for bringing the epidemic under control. Before the authors can use models to predict the future, they must carefully test them against the past spread of the infection and for sensitivity to parameter changes. The long and extremely variable incubation period and the low probability of transmitting the AIDS virus in a single contact imply that population structure and variations in infectivity both play an important role in its spread. The population structure is caused by differences between people in numbers of sexual partners and the use of intravenous drugs and because of the way in which people mix among age, ethnic, and social groups. They use a simplified approach to investigate the effects of variation in incubation periods and infectivity specific to the AIDS virus, and they compare a model of

random partner choices with a model in which partners both come from similar behavior groups.

## 5530 Agriculture And Food Technology

*REFER ALSO TO CITATION(S) 7246, 7839, 9323, 9324, 9530*

9473 **(BARC—1402) Pest Control Section Biochemical Group, Progress Report 1982-86.** (Bhabha Atomic Research Centre, Bombay (India)). 1988. 34p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704993/JAW.

Reserch efforts in the Pest Control Section, BARC, a continuator of insect sterilization and pest control section of the erstwhile Biology and Agriculture Division, were continued to develop integrated management practices for the control of important insect pests of agricultural and medical importance. Insect pests chosen are, ubiquitous potato tuberworm, a serious pest of potatoes, cotton bollworms with particular reference to spotted bollworms and a mosquito (Culex fatigans), a vector of filariasis. Keeping these insects as targets, research activities have been concentrated in the fields of biological control with parasities, pathogens and sterile insects, sex pheromones and insect plant interaction with a view to integrate pest management programme. Besides, the research activity also encompasses investigations of basic nature in the fields of insect sex pheromones, insect pathology and insect plant interaction. Studies on insect pheromones relate to the modifying influence of abiotic and biotic factors of the environment on pheromone production and perception and the possibility of insect developing resistance to pheromones. Studies in the field of insect plant interaction are directed towards identifying weak links in the insect plant relationship with a view to exploit them for developing control. Basic studies in the field of insect pathology relate to isolation and identification of entomopathogens, source of their pathogenecity, improvement in their virulence and formulation of cheaper and potent microbial insecticides. This report pertains to the period 1982-86. (Orig.). 11 tables, 5 figures.

9474 **(CNIC—00062) Study on absorption and utilization of nitrogen and phosphorus from fertilizers using isotopes /sup 15/N and /sup 32/P in crops.** Wen Xianfang; Chang Xizhong; Chen Yizhu. (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). 1987. 16p. (In Chinese). (AC-IAAE—0001). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705029/JAW.

The results of the study on absorption and utilization of nitrogen and phosphorus from fertilizers by crops with isotopes /sup 15/N and /sup 32/P in 1983 ~ 1986 were described. The experiment showed that in paddy field, the rates of utilization of ammonium nitrogen by rice from (/sup 15/NH/sub 4/)/sub 2/SO/sub 4/ and /sup 15/NH/sub 4/NO/sub 3/ are 40.58% and 33.80%, respectively, and that of nitrate nitrogen from NH/sub 4//sup 15/NO/sub 3/ and K/sup 15/NO/sub 3/, 15.99% and 15.30%, respectively. The rates of utilization of ammonium nitrogen by rice is significantly higher than that of nitrate nitrogen. In upland field, the rates of utilization of nitrate nitrogen by millet from NH/sub 4//sup 15/NO/sub 3/ and K/sup 15/NO/sub 3/ are 71.6% and 59.5%, respectively, and that of ammonium nitrogen from (/sup 15/NH/sub 4/)/sub 2/SO/sub 4/ and /sup 15/NH/sub 4/NO/sub 3/, 52.4% and 42.2%, respectively; the rates of utilization of nitrate nitrogen by millet is significantly higher than that of ammonium nitrogen. Uptake and utilization of nitrogen and phosphorus by rice were studied with /sup 15/N and /sup 32/P as tracers. Efficiencies of utilization of nitrogen are as follows: for urea-ammonium phosphate, 44.65%; for ammonium phosphate-chloride, 45.5%; for urea, 44.12%; and for nitric phosphate, 36.65%. Efficiencies of utilization of phosphorus are as follows: 22.5% for nitric phosphate, 22.36% for ammonium phosphate-chloride, 21.08% for urea-ammonium phosphate, 20.74% for urea+superphosphate, and 11.80% for superphosphate. The determination of radioactive scanning and autoradiography method show that after 20 days the vertical moving distances of the /sup 32/P of fertilizers in the soil, in the order, are as follows: 4.21 cm for nitric phosphate, 4.20 cm for urea-ammonium phosphate, 4.01 cm for ammonium phosphate-chloride, 3.50 cm for urea+superphosphate, 3.12 cm for ammonium phosphate-sulfate, and 3.00 cm for superphosphate.

9475 **(INIS-BR—1346) Evaluation of two radiographic developers by Sensitometric methodology.** Alcantara, T.M.C. (Sao Paulo Univ., Bauru, SP (Brazil). Faculdade de Odontologia). 1976. 86p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705145/JAW.

The results obtained by processing Eastman KODAK's Periapical ultra speed film in a solution primarily suggested for use in automatic processors are evaluated though the characteristic curve. The solution tested (Tiplimatic) was employed at 30/sup 0/C during 30 seconds. The activity of this solution was also studied, during 80 days. (M.A.C.).

9476 **(INIS-XN—135) Order of 6 Jan 1988 on the treatment by ionizing radiation of dried fruits and vegetables.** (International Atomic Energy Agency, Vienna (Austria)). 13 Jan 1988. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704926/JAW.

Published in Journal Officiel de la Republique Francaise.

This Order specifies the conditions required for authorizing possession with a view to sale or putting on sale dried vegetables and dried fruit which have been irradiated for purposes of insect control through exposure to cobalt 60 or caesium 137 gamma radiation or to electron beams with an energy below or equal to 10 million electron-volts.

# 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

## 5601 Radiation Effects

*REFER ALSO TO CITATION(S) 7507, 7509, 7826, 9077, 9480*

9477 **(AD-A—197281/9/XAB) AFRRI (Armed Forces Radiobiology Research Institute) reports, January, February and March 1988. Technical report.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). May 1988. 95p. NTIS, PC A05/MF A01.

Includes rept. nos. AFRRI-SR88-1 through AFRRI-SR88-9 and AFRRI-TR88-1.

A possible mechanism by which disodium cromoglycate (DSCG) prevents a decrease in regional cerebral blood flow but not hypotension in primates following whole body gamma irradiation was studied. Several studies have implicated superoxide radicals in intestinal and cerebral vascular disorders following ischemia and ionizing radiation, respectively, The superoxide radical is formed during radiolysis in the reaction between hydrated electrons and dissolved oxygen. For this reason, the efficiency of DSCG to scavenge hydrated electrons and possibly prevent the formation of the superoxide radical was studied. The results show that DSCG is an efficient hydrated-electrons scavenger and may effectively compete with oxygen for hydrated electrons preventing the radiolytic formation of the superoxide radicals.

9478 **(AD-A—198154/7/XAB) Center for Basic Research in Radiation Bioeffects. Final report, 1 October 1987-31 March 1988.** Meltz, M.L. (Texas Univ., San Antonio (USA). Health Science Center). 15 Jun 1988. 36p. NTIS, PC A03/MF A01.

The opportunity for university-located biomedical research scientists to investigate the health hazards associated with radiofrequency radiation (RFR) exposure has been limited by the absence of the necessary exposure facilities at their institutions, in close proximity to the laboratories where biological systems are maintained. To eliminate this difficulty, and as a means of encouraging greater participation by physicians and biomedical researchers in answering the numerous questions that have been, are being, or will be raised as to possible adverse health effects of non-ionizing RFR, a unique facility was designed and constructed in the Department of Radiology at the University of Texas Health Science Center at San Antonio (UTHSCSA); it is the Center for Basic Research in

Radiation Bioeffects (CBRRB). The funding for the construction and equipping of the CBRRB came from two sources; one was the Department of Defense (U.S. Air Force) University Research Instrumentation Program ($299,849.00) (AFOSR-87-0029), and the second was the Permanent University Fund (PUF) of the University of Texas ($173,000.00). The complete facility, jointly funded by the DOD and the PUF Funds, is additionally unique in that is will allow for biological experimentation involving simultaneous RFR and x-ray (ionizing radiation) exposures, or RFR and ultraviolet light (UV) exposures. All exposures would be performed in the specially designed anechoic chamber, which is both temperature and humidity-controlled.

9479 **(ANL—88-26) Operational health physics training.** (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 928p. NTIS, PC A99/MF A01 - OSTI. Order Number DE89004616/JAW.

The initial four sections treat basic information concerning atomic structure and other useful physical quantities, natural radioactivity, the properties of $\alpha$, $\beta$, $\gamma$, x rays and neutrons, and the concepts and units of radiation dosimetry (including SI units). Section 5 deals with biological effects and the risks associated with radiation exposure. Background radiation and man-made sources are discussed next. The basic recommendations of the ICRP concerning dose limitations: justification, optimization (ALARA concepts and applications) and dose limits are covered in Section seven. Section eight is an expanded version of shielding, and the internal dosimetry discussion has been extensively revised to reflect the concepts contained in the MIRD methodology and ICRP 30. The remaining sections discuss the operational health physics approach to monitoring radiation. Individual sections include radiation detection principles, instrument operation and counting statistics, health physics instruments and personnel monitoring devices. The last five sections deal with the nature of, operation principles of, health physics aspects of, and monitoring approaches to air sampling, reactors, nuclear safety, gloveboxes and hot cells, accelerators and x ray sources. Decontamination, waste disposal and transportation of radionuclides are added topics. Several appendices containing constants, symbols, selected mathematical topics, and the Chart of the Nuclides, and an index have been included.

9480 **(CNIC—00077) Effects of /sup 60/Co γ-rays on PWM and LPS induced lymphocytes.** Su Liaoyuan; Liu Fenju; Liu Keliang; Xu Changshao; Yu Zhiying; Geng Yongzhi; Xu Yingdong; Lu Li; Yao Deyuan; Gao Yaoming. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 5p. (In Chinese). (SMC—0006). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705033/JAW.

The relationship between lymphocytes induced by PWM and LPS was investigated by means of /sup 3/H-TdR and /sup 14/C-UR incorporation. The study showed that in votro, PWM-induced cells were able to promote the stimulating effect of LPS to B lymphocyte. The stimulating effect of PWM-induced cells was obviously weakened after PWM cells being irradiated with γ-rays. When PWM-induced cells and LPS-induced cells were incubated together, with one kind of cells exposed to /sup 60/Co γ-rays, incorporation value of /sup 3/H-TdR became much smaller and the synergetic function disappeared, especially, when PWM-induced cells were irradiated. For patients suffering from carcinoma of nasopharynx, when treated with /sup 60/Co γ-rays, the incorporation value in LPS-induced cells approached normal level, while the incorporation value in PWM-induced cells reduced significantly and the stimulating effect of PWM-induced cells on LPS-induced cells became much weaker. The fact described above demonstrated that PWM-induced cells have the function of T-helper cells and play a more important role in the synergy than LPS induced cells.

9481 **(CNIC—00078) Research into effects of ionizing radiation on immune function.** Mao Zijun; Yin Zhiwei; Yu Jiechang; Zhang Xueguang; Yang Huixin; Feng Shuyi. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 8p. (In Chinese). (SMC—0007). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705034/JAW.

The effects of ionizing radiation on immune function were investigated. After irradiation, the changes of the lymphocytes and their subpopulations were observed by using T-and B-lymphocyte transformation induced by mitogens PHA or DS, E, E/sub a/, ZC/sub 3/, M/sub E/, EAG(T/sub γ/) and EAM(T/sub μ/) rosette forming assay, and nonspecific esterase staining (ANAE) as a method of detecting T cells and determining LDH isoenzyme patterns of T-and B-lymphocytes. The experimental results indicated that: (1) Lymphocytes were a highly radiosensitive and heterogeneous cell population. B cells are more radiosensitive than T cells. T/sub γ/ cells are more radiosensitive than T/sub μ/ cells; (2) The nonspecific transformation of T-and B-lymphocytes was one of the radiosensitive indices, and the B-lymphocyte transformation was more sensitive to radiation effect than T-lymphocyte transformation; (3) Ionixing radiation had a significant inhibiting effect on the ability of E rosette formation and ANAE activity. Moreover, heavier inhibition on ANAE staining seemed to be more effective in showing up irradiation impairment; (4) After medium doses of /sup 60/Co γ-ray irradiation, the relative percentage of LDH/sub 5/ in both T and B cells increased, but the increase of LDH/sub 5/ in T cells in comparison with the control group was not statistically significant. The percentage of LDH/sub 5/ in B cells irradiated by 2.5 or 5.0 Gy had a significant difference compared with the control group ($P < 0.05$); (5) Apart from DNA macromolecules in cell nucleus, complex membrane system may be another important target for radiation-induced damage.

9482 **(CNIC—00081) Studies on protective effects of superoxide dismutase on radiation induced-chromosomal aberrations.** Zheng Siying; Jiang Jiagui; Lin Xingcheng. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 5p. (In Chinese). (SMC—0010). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705036/JAW.

This study demonstrates that radiation induced-chromosomal aberrations are not only due to the direct effect of radiation /sup h/it/sup ,/ but the indirect effect of free radical as well. Therefore, chromosome damage induced by radiation may be reduced by adding exogenous SOD into the radiation exposed lymphocyte culture to eliminate the superoxide free radical which damages DNA. On the other hand, however, the radiosensitivity of lymphocytes can be raised by adding SOD inhibitor (DDC) into the lymphocyte culture, which makes radiation induced-chromosomal damages more severely.

9483 **(CNIC—00111) Biological effects of low let on recognition functions of plasma membrane of lymphocytes.** Mao Zijun; Yin Zhiwei; Yu Jiechang; Yang Huixin. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1988. 10p. (In Chinese). (SMC—0015). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705049/JAW.

The functional changes of the receptors of human peripheral blood lymphocytes after various low doses of /sup 60/Co γ-ray irradiation were investigated by using E-, E/sub a/-, and M/sub E/-rosette formation, FITC-SPA- or FITC-IgG-immunofluorescence test, capping of surface membrane receptors, aggregation of lymphocytes induced by Con A, and electron microscopic observation. Besides, some lymphocytes were treated with cytochalasin B or colchicine in order to compare their effects with that of γ-ray irradiation. The experimental results suggested that the mechanism of the inhibitory effect of ionizing radiation might be related to the destruction of microfilaments and microtubules in addition to its direct effect. In addition, various immunological tests were undertaken in patients with malignant tumors before and after /sup 60/Co γ-ray therapy. The radioprotective effect of superoxide dismutase on growth of mouse spleen cell colonies (CFU-C) in vitro was also observed.

9484 **(CNIC—00140) Mutagenic effects of /sup 60/Co gamma ray combined with EMS in wheat.** Liang Qu; Wang Linqing. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Jan 1988. 14p. (In Chinese). (AC-IAAE—0013). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705055/JAW.

Dry seeds of 3 varieties of wheat were treated with 2.58, 3.87, 5.16, 6.45 C/kg of gamma rays, 0.1%, 0.2%, 0.3%, 0.4% concentrations of EMS and their combination. The biological effects of M/sub 1/ and mutation frequency of M/sub 2/ were studied. The results showed that the biological injuries of M/sub 1/ increased with dose of γ-ray and concentration of EMS. The additive effects were observed on percentage of the root tip cells with micronuclei, rates of emergence, seedling height; plant height and number of sterile spikes per plant and synergic effects on the sterile rate of the first spike and survival rate, M/sub 1/ biological injuries were modified by different methods of pre-treatment. It was found that combination treatments with γ-ray and EMS were more effective than single treatment of either mutagen for inducing mutation in M/sub 2/. The results of this study suggested that 5.16 C/kg γ-ray + 0.3% EMS was the most effective dose for inducing mutation. The mutation frequency of M/sub 2/ was closely related to the precentage of root tip cells with single micronuclei, which can be used for predicting the mutagenic effect of combined treatment.

9485 **(CONF-8707103—Absts.) International congress on DNA damage and repair: Book of abstracts.** (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 107p. NTIS, PC A06 - OSTI. Order Number DE89003548/JAW.

From International congress on DNA damage and repair; Rome, Italy (12 Jul 1987).

This document contains the abstracts of 105 papers presented at the Congress. Topics covered include the Escherichia coli nucleotide excision repair system, DNA repair in malignant transformations, defective DNA repair, and gene regulation. (TEM)

9486 **(CONF-8809137—5) Influence of dose rate on the transformation of Syrian hamster embryo cells by fission-spectrum neutrons.** Jones, C.A.; Sedita, B.A.; Hill, C.K.; Elkind, M.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003657/JAW.

From 14. L. H. Gray conference; Oxford, UK (11 Sep 1988).

Several explanations for this neutron dose-rate effect have been proposed, but further investigation is necessary to determine the mechanisms involved. In all cell transformation studies to date the immortalized, aneuploid 10T1/2 cell-line has been used. These cells may be premalignant; thus their response characteristics and, in particular, the nature of the transformation event, might differ from that in a normal, fibroblast cell. One reason for the present study was to determine whether the low-dose-rate effect of fission neutrons could be demonstrated in normal cells. If so, a normal cell system, which would more closely resemble a normal in vivo system, could be used for mechanistic studies. We chose Syrian hamster embryo (SHE) fibroblasts which are normal, diploid cells with a limited life span in culture. Upon exposure to low doses of ionizing radiation, the fraction of the cells that are transformed can be identified in a standard 8--10 day colony assay by examining their clonal morphology. Transformed cells form colonies with a dense, criss-crossed or piled-up structure. A high percentage of the transformed colonies can be further propagated and will acquire additional neoplastic characteristics; i.e., anchorage independence, immortality, altered proteolytic activity, karyotype alterations, and finally, tumorigenicity.

9487 **(CORR—86-00182) [Development of minicomputer software for the SRP whole body counter-PDP-11 Fortran].** Watts, J.R. (Techniserv Data Systems, Inc., Teaneck, NJ (USA)). 10 Jun 1986. Contract AC09-76SR00001. 30p. NTIS, PC A03 - OSTI. Order Number DE89003501/JAW.

The Computerized Whole Body Counter System consists of computer equipment, a multiple channel analyzer (MCA), and programs that collect, record, store, and report data. System hardware consists of a Digital PDP11/23-Plus computer interfaced with a Canberra Series 90 MCA, 2 CRT terminals, 2 printers, and data storage devices. The system utilizes locally-written PDP-11 Fortran IV programs/subroutines, Canberra ETXX73 subroutines to interact with the MCA, and PDP-11 Fortran Library subroutines. The User Guide provides detailed instruction for operating the computer and executing the tasks. The Programmer Guide provides detail that a programmer may need to maintain the source code and to rebuild the tasks.

9488 **(DGT—33061) Study of biological effects and radiation protection to future European manned space flights. Final report.** Bourrieau, J.; Berry, J.; Philippon, J.P.; Roux, M.; Reitz, G.; Facius, R.; Schafer, M.; Schott, J.U.; Bucker, H.; Horneck, G. (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)). Feb 1988. 325p. (ESA-CR(P)—2553; ETN—88-92775). NTIS, PC A14/MF A01.

The Earth's radiation environment; radiation dose calculation and measurement; foreseen exposure in European manned space missions; biological effects of radiation; and radiation monitoring and protection are discussed.

9489 **(DOE/ER—0396) Radon inhalation studies in animals.** Cross, F.T. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 62p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004441/JAW.

This report highlights the more recent animal data from the two US studies (UR and PNL) and the French (COGEMA) study. A major report, which particularly addressed the early, acute, radon-toxicity studies, concluded (as did an earlier Federal Radiation Council report), that experimental work prior to the 1970s had not shown that it was possible to produce pulmonary carcinomas in animals, in a systematic way, from controlled exposures to radon and its progeny. Since that review, a discussion of the biological effects in animals of inhaled radon and radon-decay products has appeared. The current literature review report extensively updates the biological-effects data and discussions in the animal data chapter of the book "Radon and Its Decay Products in Indoor Air." Emphasis is placed on the carcinogenic effects of radon and radon-decay products, including the influences of radon-progeny exposure rate, unattached fraction and disequilibrium, and coexposure to other pollutants. These data are correlated with human epidemiological data. Plausible values for the radon (radon-progeny) lifetime lung-cancer risk coefficients are also provided. Sections II, III and IV include general descriptions of materials and methods, as well as major research findings, for the radon toxicology and dosimetry studies conducted at UR, COGEMA and PNL. Section V is a condensation of the more detailed data of the previous sections and includes discussions, conclusions, and tables regarding the dosimetry and carcinogenicity of radon exposures. Section VI contains detailed species-specific data on exposure-effect relationships for all major biological effects caused by radon exposures. Section VII contrasts the human and animal radon-exposure data. 76 refs., 3 figs., 5 tabs.

9490 **(DOE/ER/60105—T1) Assessment of leukemia and thyroid disease in relation to fallout in Utah: Annual progress report.** (National Institutes of Health, Bethesda, MD (USA)). 14 Apr 1988. Contract AI01-82ER60105. 234p. NTIS, PC A11/MF A01 - OSTI. Order Number DE89003526/JAW.

This report contains the results of one year's work on the effects of fallout on the development of leukemia and thyroid disease in humans residing in Utah. Divided into 37 subphases, this report evaluates the development of predictive models, the use of dosimetry, and various cohort studies. (FI)

9491 **(EPRI-EA—6112) Radiation worker health study: Scoping phase: Final report.** Dreyer, N.A.; Wilkinson, G.S.; Loughlin, J.E. (Electric Power Research Inst., Palo Alto, CA (USA); Epidemiology Resources, Inc., Chestnut Hill, MA (USA)). Nov 1988. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004246/JAW.

The purpose of this project was to develop a scope of work for an epidemiologic study of the health of workers at nuclear utilities. We propose a study of cancer mortality among electric utility personnel assigned to nuclear generating stations. The primary goal of the study is to provide information to assist in maintaining a healthy work environment in electric utilities; such information would also help to resolve some uncertainties about the effects of low-level ionizing radiation by providing direct observation of human beings exposed at low doses and dose rates. Workers at each nuclear generating station would be identified from company

records, their dose histories would be collected, and their vital status would be ascertained as well as cause of death, if deceased. This study would be historical in that past records would be used and prospective in that employees would continue to be followed in future years. Our estimates indicate that a study population composed of employees and contractors at all commercial nuclear generating stations would total approximately 2,000,000 person-years of observation and would be adequate to detect (or exclude) a 50 percent increase in leukemia with reasonable statistical power. 44 refs., 4 figs., 3 tabs.

9492 **(GSF—1/87) Placental transfer of calcium and strontium and of their radionuclides. Report on experimental findings and on literature data.** Griessl, I.; Stieve, F.E. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz; Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). Nov 1987. 463p. (In German). NTIS (US Sales Only), PC A20/MF A01. Order Number DE88755938/JAW.

The first part of the report deals with the occurrence and the chemistry of strontium and its radioisotopes, and the second part discusses the calcium and the strontium metabolism in man. General information on the biology and physiology of the human skeleton is given in part 3, whereas part 4 again discusses the calcium and strontium metabolism in man, however with particular emphasis on the conditions during pregnancy and lactation. Part 5 presents an evaluation of the literature in this subject field, concentrating on results obtained with experimental animals such as cows, swine, dogs, guinea pigs, rats, and mice, and discusses the applicability of these findings to the conditions in man. An annex presents data on the yttrium metabolism in man and animal.

9493 **(GSI—88-51-Prepr.) Free radicals induced in solid DNA by heavy-ion bombardment.** Huettermann, J.; Schaefer, A.; Kraft, G. (Universitaet des Saarlandes, Homburg/Saar (Germany, F.R.). Fachrichtung Biophysik und Physikalische Grundlagen der Medizin). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1988. 11p. (CONF-8807140—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From 11. COSPAR symposium on cosmic ray studies in space; Helsinki, Finland (18 Jul 1988).

Free radical formation after heavy-ion bombardment was studied in solid, polycrystalline pellets of DNA-constituents by analysing the dose-yield curves and the spectra obtained by ESR-spectroscopy at low (< 100 K) and ambient temperatures. The dose-yield curves were found to correlate with those found after X-irradiation but shifted to higher doses and lower saturation concentrations. The corresponding radical yields (per 100 eV) exhibit values which are one to two orders of magnitudes lower. The structural aspects as revealed from powder ESR-spectra gave a complex interrelation between substance, LET, dose and irradiation temperature, which is discussed in terms of mechanistic models.

9494 **(INFO—0192) Transfer of radionuclides from the environment to human milk. A review.** Eaman, M. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Jun 1986. 40p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705117/JAW.

The author reviews literature from an on-line bibliographic search and describes what is known about radionuclide and elemental transfer from the environment to human milk. Included in the review are factors affecting elemental transfer, element concentrations observed in human milk, as well as sampling and analytical methods used. Recommendations are given for the development of a field survey. 59 refs.

9495 (INIS-SU—68, pp 513) **Possibilities of the method of perturbed angular gamma-gamma correlations in studying of medical and biological objects.** Aksel'rod, Z.Z.; Sorokin, A.A.; Chelyapov, N.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9496 (INIS-SU—68, pp 512) **Study of interaction of / sup 111/Cd with living cell by method of perturbed angular γγ-correlations.** Aksel'rod, Z.Z.; Ichetovkina, L.E.; Komissarova, B.A.; Ryasnyj, G.K.; Semenov, S.I.; Sorokin, A.A.; Chelyapov, N.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9497 **(INIS-XN—139) Staatsblad 465 - Decree of 10 September 1986 made in implementation of Sections 28 to 32 and Section 34 of the Nuclear Energy Act (Radiation Protection Decree).** (International Atomic Energy Agency, Vienna (Austria)). 10 Sep 1987. 41p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704930/JAW.

This Decree implements at national level the Directive of the Council of the European Communities of 15 July 1980 (No. 80/836 EURATOM) amending the Community basic safety standards for radiation protection. The Decree, which replaces the Radioactive Materials Decree of 1969 (Stb. 1969, No. 404), regulates the protection of the public and workers against the hazards of radiation from radioactive materials and apparatus, in accordance with the provisions of the above Directive. In addition, it lays down a licensing system for the use of radioactive materials and radiation-emitting apparatus and prescribes general rules in their respect.

9498 **(KEK—87-29) Radiation biology studies in soft x-ray and ultrasoft x-ray region.** Kobayashi, Katsumi (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1988. 50p. (In Japanese). (CONF-8706364—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756071/JAW.

From Workshop on radiation biology studies in soft X-ray and ultrasoft x-ray region; Tsukuba, Japan (17 Jun 1987).

The aim of the radiation biology group in the PF is to investigate into the radiation biological effect of monochromatic SR light from ultraviolet to x-ray region, and to clarify the mechanism of biological action of radiation including corpuscular beam and gamma ray, in particular, its initial process. As the requirement for the purpose, the equipment of irradiating the monochromatic SR light over the whole region on living things and the room for specimen preparation and effect test, in which the radioisotopes indispensable for elucidating the responding process of living things can be used, have been made to be ready for use. Two irradiation systems for the monochromatic x-ray from 0.8 A to 3 A and the monochromatic soft x-ray from 4 A to 7 A were provided. Besides, an oblique incidence spectroscope for the ultrasoft x-ray from 40 A to 400 A region is equipped. By the combined use with a vacuum irradiation equipment, the above mentioned aim approaches one step closer to the realization. Especially, the soft x-ray irradiation system is expected to contribute to the research on the mechanism of causing DNA injury and the response to it. The study meeting was held on June 17 and 18, 1987, and the reports are collected in this book. (Kako, I.).

9499 **(KFK—4051) Institute of Genetics and Toxicology of Fission Products (IGT) of Karlsruhe Nuclear Research Centre. Progress report on R and D work in 1985.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Feb 1986. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755965/JAW.

The main research activities of the IGT in 1985 according to the R and D programme set up for that year have been carried out under the roof of eight different projects or programmes: Gene repair; gene regulation; biological carcinogenesis; molecular genetics of eukaryotes; radiotoxicology of actinides; biochemistry of actinides and other heavy metals; biophysics of organometallic compounds; biochemical principles of decorporation therapy.

9500 **(KURRI-TR—306) Proceedings of the symposium on radiation-induced chromosomal aberrations.** Ikushima, Takaji (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jul 1988. 49p. (In Japanese). (CONF-8802121—). NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE89003362/JAW.

From Symposium on radiation-induced chromosomal aberrations; Kyoto, Japan (19 Feb 1988).

The induction of chromosomal aberrations by radiation is an old and new problem in radiation biology. The studies on radiation-induced chromosomal aberrations have contributed to understanding the structure and function of chromosomes which are endowed with precise genetic information. Since chromosomal structural change is a most sensitive indicator expressed at the early stage after radiation exposure, it has been a useful monitor for exposure in Atomic-bomb survivors in Hiroshima and Nagasaki. Recent revolutional development of gene manipulation has been revealing the functional importance of chromosomal aberrations in carcinogenesis; e.g., they play as triggers of oncogene-activation. At the present symposium we tried to review the current status and to explore the future direction of the research on "Radiation-induced Chromosomal Aberrations." Topics discussed in the symposium were as follows: the mechanism for formation of chromosomal aberrations, chromosomal aberrations observed in lymphocytes of Atomic-bomb survivors, heritable chromosome- breakage syndromes in human, induction of sister chromatid exchanges and their biological significance, gene amplification in cancer cells, and micro-cloning of chromosome. This proceedings is the compilation of the papers presented at the symposium.

9501 **(LBL—25446) Magnetically scanned ion beams for radiation therapy.** Alonso, J.R. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 12p. (CONF-881151—49). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004650/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The advantageous physical characteristics of slowing-down and stopping charged particle ion beams have been demonstrated to be highly desirable for application to radiation therapy. Specifically, the prospect of concentrating the dose delivered into a sharp-defined treatment volume while keeping to a minimum the total dose to tissues outside this volume is most appealing, offering very significant improvements over what is possible with established radiation therapy techniques. Key to achieving this physical dose distribution in an actual treatment setting is the technique used for delivering the beam into the patient. Magnetically scanned beams are emerging as the technique of choice, but daunting problems remain still in achieving the utmost theoretically possible dose distributions. 21 refs., 2 figs.

9502 **(NIRS-R—14) Final report on 'biological effects of tritium as a basis of research and development in nuclear fusion'. April 1981 - March 1986.** (National Inst. of Radiological Sciences, Chiba (Japan)). Dec 1987. 119p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756077/JAW.

The National Institute of Radiological Sciences, Japan, has undertaken a special study of "biological effects of tritium as a basis of research and development in nuclear fusion" over a 5-year period from April 1981 through March 1986. This is a final report, covering incorporation and metabolism of tritium, physical, chemical, and cellular effects of tritium, tritium damage to the mammalian tissue, and human exposure to tritium. The report is organized into five chapters, including "Study of incorporation of tritium into the living body and its in vivo behavior"; "Physical and chemical studies for the determination of relative biological effectiveness"; "Analytical study on biological effects of tritium in cultured mammalian cells"; "Study of tritium effects on the mammalian tissue, germ cells, and cell transformation"; and "Changes in the hemopoietic stem cells and lymphocyte subsets in humans after exposure to some internal emitters". (Namekawa, K.).

9503 **(OEFZS—4459) Sister Chromatid Exchanges (=SCEs) in Lymphocytes of persons working at Shlobin (USSR), 150km north of Chernobyl.** Tuschl, H.; Kovac, R. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Aug 1988. 8p. (BL—749/88). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704892/JAW.

SCEs are considered to be a sensitive indicator for the DNA damaging effects of mutagenic and carcinogenic agents. In 1986, during the Chernobyl accident, employees of an Austrian company worked at Shlobin, 150km north of Chernobyl. At their return to Austria blood as taken and spontaneously occurring and MMC induced SCEs were studied. Spontaneously occurring SCEs in lymphocytes of 'exposed' and 'unexposed' persons were only insignificantly different when results were summarized for all test persons. A significant influence of smoking could be established. When results were correlated with the time interval between the Chernobyl accident and the date of blood sampling, the increased rate of spontaneous SCEs observed soon after the accident decreased to the normal range during the following months. Irrespective of the molecular mechanism that might be the rationale for the observed decreased induction of SCEs in lymphocytes of exposed persons, the estimation of MMC induced SCEs proved to be the most sensitive test to demonstrate population exposure to low doses of ionizing radiation. 7 refs., 1 fig., 5 tabs.

9504 **(OEFZS—4462) Continuous induction of unscheduled DNA synthesis by gamma irradiation.** Weniger, P.; Klein, W.; Ott, E.; Kocsis, F.; Altmann, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Aug 1988. 7p. (BL—751/88). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705209/JAW.

The induction of DNA-synthesis in non-S-phase cells is a very sensitive measure of a preceding damage of the DNA. Usually, in an in vivo -in vitro test (treatment of an animal, incorporation of H3-thymidine in a cell suspension) the damaging of DNA takes place hours to days before the evaluation. In this case, the time course of the UDS-induction after a single dose of 1 Gy gamma irradiation should be observed for a long time (21 months). C57 black mice served as test animals. In an age of about 80 days they were irradiated and the induction of unscheduled DNA synthesis was measured at ten points of time during the whole life-span of the animals. Although the repair in this gamma radiation damage in DNA is a very quick process - with centrifugation in alkaline sucrose you find a half time of some minutes - an induction of unscheduled DNA synthesis could be seen at the irradiated animals until the end of their life (640 days). The reason for this could be permanent disorders in cellular regulation caused by the gamma irradiation. 4 figs.

9505 **(PB—89-105043/XAB) For the interim, the proposed central estimate and range in EPA's (Environmental Protection Agency's) low-LET risk estimate for regulatory purposes are acceptable. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 Sep 1988. 7p. (SAB/RAC—88/041). NTIS, PC A02/MF A01.

The EPA Science Advisory Board's (SAB) Radiation Advisory Committee has reviewed EPA's Low-LET Risk Estimate for Regulatory Purposes and determined that, on an interim basis, the nominal central estimate of 400 fatal cancers and a range of 120-1200 additional fatal cancers per million persons exposed to one rad of low-LET radiation is acceptable. However, several important reports and radiation risks are expected within the year which could alter the understanding of their magnitude. The reports are based, in part, on new information from Japan on the survivors of the atomic bombing of Hiroshima and Nagasaki. The SAB urges EPA to take the findings and conclusions of such reports into account in the development of final regulations on radionuclides in the environment.

9506 **(PNL—6067-Vol.3) Recommended procedures for performance testing of radiobioassay laboratories: Volume 3, In vivo test phantoms.** MacLellan, J.A.; Traub, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004256/JAW.

Draft American National Standards Institute (ANSI) Standard N13.30 (Performance Criteria for Radiobioassay) was developed for the US Department of Energy and the US Nuclear Regulatory Commission to help ensure that bioassay laboratories provide accurate and consistent results. The draft standard describes the procedures necessary to establish a bioassay performance-testing laboratory and program. The bioassay performance-testing laboratory will conduct tests to evaluate the performance of service laboratories. Pacific Northwest Laboratory helped develop testing procedures as part of an effort to evaluate the draft ANSI N13.30 performance criteria by testing the existing measurement capabilities of various bioassay laboratories. This report recommends guidelines for the preparation, handling, storage, distribution, shipping, and documentation of test phantoms used for calibration of measurement systems for direct bioassay. The data base and recommended records system for documenting radiobioassay performance at the service laboratories are also presented.

9507 **(PNL—6584-Vol.1) GENII: The Hanford Environmental Radiation Dosimetry Software System: Volume 1, Conceptual representation.** Napier, B.A.; Peloquin, R.A.; Strenge, D.L.; Ramsdell, J.V. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 176p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004462/JAW.

The Hanford Environmental Dosimetry Upgrade Project was undertaken to incorporate the internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in updated versions of the environmental pathway analysis models used at Hanford. The resulting second generation of Hanford environmental dosimetry computer codes is compiled in the Hanford Environmental Dosimetry System (Generation II, or GENII). The purpose of this coupled system of computer codes is to analyze environmental contamination resulting from acute or chronic releases to, or initial contamination of, air, water, or soil. This is accomplished by calculating radiation doses to individuals or populations. GENII is described in three volumes of documentation. The first volume describes the theoretical considerations of the system. The second volume is a Users' Manual, providing code structure, users' instructions, required system configurations, and QA-related topics. The third volume is a Code Maintenance Manual for the user who requires knowledge of code detail. It includes code logic diagrams, global dictionary, worksheets, example hand calculations, and listings of the code and its associated data libraries. 72 refs., 15 figs., 34 tabs.

9508 **(RERF-TR—11-85) Diabetes, glycosuria, and proteinuria in a Japanese cohort followed for 20 years.** Brodsky, J.B.; Moore, D.F.; Hamilton, H.B.; Kawate, Ryoso. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jul 1988. 33p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756080/JAW.

An analysis of noninsulin-dependent diabetes mellitus, glycosuria, and proteinuria in a Japanese cohort, which has been followed for 20 years, is presented. For the last 14 years of follow-up in Hiroshima, the sex-specific incidence rates of diabetes were approximately constant at 1.2 - 1.4 cases/100 per 2-year interval for males ($p > .50$) and at 0.5 - 0.6 cases/100 per 2-year interval for females ($p > .20$). The diagnosis of diabetes depended on first screening for glycosuria and then administering an oral glucose tolerance test only to those with glycosuria. The relatively greater prevalence of glycosuria and diabetes among males has also been noted by others using similar methods. It has been reported elsewhere that if the glucose tolerance test were used to screen for diabetes, the sex difference may not be apparent. The prevalence of diabetes increased over the course of study ($p < .001$), and the increase was attributed to aging of the cohort. The size of the undiagnosed diabetic population was estimated and the observed prevalence rate was determined to be about 75 % of the actual prevalence rate at the end of 8 years of follow-up and to be about 89 % of the actual prevalence rate at the end of 20 years of follow-up. Proteinuria prevalence was 4.3 % in nondiabetics, 23.5 % in Hiroshima diabetics, and 18.7 % in Nagasaki diabetics. The differences in prevalence rates between nondiabetics and diabetics were highly significant ($p < .001$).

9509 **(RERF-TR—11-86) Impact of the reassessment of A-bomb dosimetry. Dose estimation methods and preliminary cancer mortality findings.** Kopecky, K.J.; Preston, D.L. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jul 1988. 36p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756081/JAW.

This report examines the anticipated impact of the adoption by RERF of a new atomic bomb radiation dosimetry system to replace the revised tentative 1965 dosimetry system (T65DR). The current binational effort to reassess A-bomb dosimetry will eventually produce information about air doses and attenuation due to shielding by structures and body tissue. A method for computing individual survivors' total body surface exposure doses and organ doses from such data was developed, and a set of interim 1985 dosimetry (I85D) estimates was computed by this method using the data available to RERF in late 1984. Estimates of I85D total body surface exposure doses could be computed for 64,804 of 91,231 exposed survivors with T65DR dose estimates; following present plans, revised dose estimates may become available for an additional group of 10,000 to 12,000 exposed survivors. Mortality from leukemia and from all cancers except leukemia was examined in relation to I85D total body surface exposure doses (gamma plus neutron); parallel analyses using T65DR exposure doses were also conducted for the same set of survivors. Overall estimates of radiogenic excess risk based on I85D total body surface doses were about 50 % greater than those based on T65DR doses. Nonsignificant differences of only 3 % or less between the radiogenic excess risks for Hiroshima and Nagasaki survivors were observed in relation to I85D doses. Modification of the radiation dose response by sex, age at the time of the bombing, or time since exposure was qualitatively similar for I85D and T65DR. For both leukemia and nonleukemic cancer mortality, the radiogenic excess risk was found to increase as a linear function of I85D total body surface dose; significantly poorer fits were obtained with pure quadratic dose-response functions, while linear-quadratic dose responses did not provide significantly better fits. (J.P.N.).

9510 **(RERF-TR—19-87) Age- and dose-related alteration of in vitro mixed lymphocyte culture response of blood lymphocytes from A-bomb survivors.** Akiyama, Mitoshi; Zhou, Ou-Liang; Kusunoki, Yoichiro; Kyoizumi, Seishi; Kohno, Nobuoki; Akiba, Suminori; Delongchamp, R.R. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jul 1988. 14p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756082/JAW.

The responsiveness of peripheral blood lymphocytes to allogenic antigens in mixed lymphocyte culture (MLC) was measured in 139 atomic bomb survivors. The study revealed a significant decrease in MLC with increasing dose of previous radiation exposure. This decline was remarkable in the survivors who were older than 15 at the time of the bomb (ATB). The results suggest a possible relationship between the recovery of T-cell-related function and the thymic function which processes mature T-cells for the immune system. Thus it may be that, in the advanced age ATB group, the thymus function has started to involute allowing less recovery of T-cell function compared to young survivors who have adequate processing T-cell activity.

9511 **(UCRL—53893) Incorporation of additional radionuclides and the external exposure pathway into the BECAMP [Basic Environmental Compliance and Monitoring Program] radiological assessment model.** Ng, Yook C.; Rodean, H.C.; Anspaugh, L.R. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 63p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004145/JAW.

The Nevada Applied Ecology Group (NAEG) Model of transport and dose for transuranic radionuclides was modified and expanded for the analysis of radionuclides other than pure alpha-emitters. Doses from internal and external exposures were estimated for the inventories and soil distributions of the individual radionuclides quantified in Areas 2 and 4 of the Nevada Test Site (NTS). We found that the dose equivalents via inhalation to liver, lungs, bone marrow, and bone surface from the plutonium isotopes and $^{241}$Am, those via ingestion to bone marrow and bone surfaces from $^{90}$Sr, and those via ingestion to all the target organs from $^{137}$Cs were the highest from internal exposures. The effective dose equivalents from $^{137}$Cs, $^{152}$Eu, and $^{154}$Eu were the highest from the external exposures. The $^{60}$Co, $^{152}$Eu, $^{154}$Eu, and $^{155}$Eu dose estimates for external exposures greatly exceeded those for internal exposures. The $^{60}$Co, $^{90}$Sr, and $^{137}$Cs dose equivalents from internal exposures were underestimated due to the adoption of some of the foodchain parameter values originally selected for $^{239}$Pu. Nonetheless, the ingestion pathway contributed significantly to the dose estimates for $^{90}$Sr and $^{137}$Cs, but contributed very much less than external exposures to the dose estimates for $^{60}$Co. Therefore, the use of more appropriate values would not alter the identification of important radionuclides, pathways, target organs, and exposure modes in this analysis. 19 refs., 13 figs., 12 tabs.

9512 **Bioeffects of electromagnetic waves.** Romero-Sierra, C. pp v of Review of Radio Science, 1984-1986. Hyde, G. Brussels, Belgium; International Scientific Radio Union (1987).

The scientific literature of these years, 1984 to 1986, on the bioeffects of electromagnetic (EM) waves includes many articles with not only the finest scientific methodology but also discriminating critical analysis and data interpretation. A better understanding of the basic interactive mechanisms was gained in recognizing that they depend on three groups of variables: the EM field, the living systems and their components, and their coupling efficiency, i.e., dosimetry and window phenomena. Although most areas of this scientific field have developed steadily during these years, some of them have attracted particular attention, e.g., dosimetry, cellular and subcellular effects, diagnostic and therapeutic applications, and pulsed EM fields.

9513 **In memoriam. Alexander Hollaender 1898-1986.** (Brookhaven National Lab., Upton, NY (USA)). *Environmental Mutagenesis;* **9**: No. 2, 107-109(1987).

Alexander Hollaender gave an early clue that there might be recovery or repair mechanisms in bacteria, although at the time the target for cell target for cell killing was not known. As one of the early investigators who used action spectra for the identification of the targets in biological systems, he was able to show that the wavelengths producing mutations were just those absorbed by nucleic acids, even though in those days nucleic acids were not known to be the genetic material. This result was the first clear indication that radiation and environmental biologists should concentrate on changes in DNA and not in proteins.

## 5602 Thermal Effects

9514 **Characterization of climatic factors affecting chilling injury in field-grown ratoon cotton.** Sachs, M.H.; Zilkah, S. (Institute of Field and Garden Crops, Bet Dagan (Israel)). *Journal of Agricultural Science;* **105**: 475-478(1985).

This study was an attempt to characterize the relationships between some climatic and environmental factors and the chilling injury to ratoon cotton during winter. The field investigations were conducted in the Nahal Soreq region of Israel. A lower rate of survival was correlated with a higher amount of rainfall, and survival rate was negatively correlated with average minimum temperature. Lower survival rate was also associated with lower elevation and full irrigation in the first growing season; thus conditions that increase soil humidity may also increase the rate of plant injury.

## 5603 Chemicals Metabolism And Toxicology

*REFER ALSO TO CITATION(S) 7250, 7254, 7288, 7289, 7290, 7349, 7594, 7595, 7596, 7597, 7611, 7612, 7613, 7614, 7616, 7617, 8089, 8477, 9142, 9173, 9177, 9179, 9181, 9186, 9193, 9226, 9259, 9284, 9298, 9299, 9300, 9301, 9302, 9303, 9304, 9305, 9307, 9309, 9316, 9344, 9351, 9362, 9375, 9389, 9390, 9391, 9449, 9469*

9515 **(AD-A—197075/5/XAB) Interactions among drinking and ground-water contaminants on renal and hepatic function. Annual report, 1 August 1987-25 July 1988.** Berndt, W.O. (Nebraska Univ., Omaha (USA). Medical Center). 25 Jul 1988. 67p. (—87-213-042-01). NTIS, PC A04/MF A01.

The intent of this proposal is to examine the effects of selected water pollutants and their interactions with chemicals known to produce liver or kidney damage. The chemicals selected for study are either ground- or surface-water contaminants or are the by-products of chlorination, and hence are drinking-water pollutants. The test compounds were selected on the basis of their potential for actions on the kidney or liver. The standard or reference substances to be used in these studies are known nephrotoxicants or hepatotoxicants. To examine the effects of certain drinking and ground-water pollutants (monochloroacetate, dichloroacetate, dichloromaleate, etc.) on hepatic and renal function in dose-response studies with particular emphasis on low-dose and multiple-dosing protocols; To examine the effects of selected drinking- and ground-water pollutants in conjunction with other drinking- and ground-water pollutants or with substances known to be nephrotoxic and or hepatotoxic (e.g., mercuric chloride, chloroform, hexachlorobutadiene, maleic acid). Some of the interactions were of a potentiative nature and some were antagonistic. Chromate appears to enhance the nephrotoxicity of some of these test compounds. All of the studies in this report suggest an important role in the tissue non-protein sulfhydryls.

9516 **(AD-A—198498/8/XAB) Tolerance following organophophate poisoning of tracheal muscle. Annual report.** Farley, J.M.; Dwyer, T.M. (Mississippi Univ., Jackson (USA). Medical Center). 21 Jul 1987. 84p. NTIS, PC A05/MF A01.

The effects of subacute exposure to the organophosphate acetylcholinesterase inhibitors (diisoprophylfluorophosphate, soman, sarin, and VX) on the binding properties of muscarinic receptors, the contractile responses, and the electrophysiological properties of swine tracheal smooth muscle were studied. Subacute organophosphate treatment decreased the number of muscarinic receptors in smooth muscle homogenates and in the surface membrane of isolated cells by 50-77%. DFP was the most potent, followed by sarin, VX, and soman. The organophosphates induced a change in the coupling of the receptor to the guanine nucleotide-binding protein, which resulted in a decrease in the number of high-affinity receptors available for agonist-induced actions. The sensitivity of the muscle to acetylcholine and bethanechol was largely unchanged by any of the organophosphates. It is concluded that tolerance development is a complex process and involves: changes in receptor number and coupling of these receptors to intra-cellular processes; changes in the sensitivity of the ganglia to cholinergic agonists; and changes in the membrane processes and channels controlling membrane potential. Surprisingly, the response of the muscle to agonists is not greatly affected even though 70% of the receptors are lost from the cell surface.

9517 **(AD-A—198574/6/XAB) Toxicity of soman. Final report, February 1983-July 1985.** Johnson, D.E.; Johanson, W.G.; Peel, H.H.; Moore, G.T.; Anzueto, A. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1985. 432p. NTIS, PC A19/MF A01.

The pathophysiological events following intravenous administration of soman and sarin were defined in baboons at dosages from 0.5 to 2 LD50. Animals were studied primarily using pentobarbital as anesthesia, but some animal tests were performed without anesthesia to determine the role of anesthesia in the results. The study also included an evaluation of ventilation modes and routes of access to the airway. Both conventional ventilation and high-frequency jet ventilation (HFJV) were evaluated. A cricothyroid cannula suitable for humans was developed and 20 prototypes were

fabricated. The results indicate that ventilation with atropine therapy is effective in treatment of nerve-agent exposures and that HFJV via a cricothyroid cannula is a very promising mode of resuscitation for battlefield applications.

9518 **(AD-A—199120/7/XAB) Role of eicosanoids in a model of smoke-induced lung injury. Final report, 1 June 1987-4 June 1988.** Witten, M.L. (Arizona Univ., Tucson (USA)). 29 Jun 1988. 35p. NTIS, PC A03/MF A01.

Smoke inhalation has been identified as a major cause of lung injury and death in fires with mortality rate of approximately 75%. Soldiers regularly occupy enclosed spaces and travel near flammable fuels. The combination of burning material and an enclosed space are major factors that lead to smoke inhalation. A combination of diesel fuel and polycarbonate plastic was used to generate smoke-induced lung injury. Rabbits were exposed to 60 tidal-volume breaths of smoke in approximately 10 minutes. Acute smoke-exposure caused changes in broncho-alveolar lavage (BAL) and plasma eicosanoid concentration, especially at 0.5 hours post-smoke exposure. In addition, there were decreases in technetium-labeled diethylene-triamine pentaacetic acid (99mTcDTPA) T1/2, increases in BAL total white cell count and alveolar macrophage acid phosphatase activity, and pathological evidence of pulmonary edema and type 2 pneumocyte injury. It is concluded that lung eicosanoids are involved in the inflammatory process caused by severe smoke inhalation. However, the specific roles these lung eicosanoids play in the smoke-induced injury process are not known at this time.

9519 **(AD-A—199196/7/XAB) Comparative inhalation toxicology of selected materials. Phase 2. Final report, January-July 1986.** Snipes, M.B.; Bice, D.E.; Burt, D.G.; Damon, E.G.; Eidson, A.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). May 1988. 188p. NTIS, PC A09/MF A01.

Male and female F344/N rats were exposed nose-only to a respirable powder of copper-zinc alloy. No rats died as a result of the exposures. Body weights were reduced relative to sham-exposed rats for rats exposed to 240 and 480 mg. hr Cu-Zn/cu.m week. All of the additional observed biological responses to inhaled Cu-Zn were restricted to the respiratory tract. Lung weights were increased due to an inflammatory response for rats exposed to 120 mg. hr Cu-Zn/cu.m or more per week. Exposure to 240 mg. hr Cu-zn/cu.m per week caused restrictive pulmonary functional disorder, as evidenced by a reduced lung capacity, reduced quasi-static compliance, reduced carbon monoxide diffusing capacity, and increased percent forced vital capacity exhaled in 0.1 second. Exposure-related responses in lavage-fluid indicators of lung damage included increased beta-glucuronidase, increased lactate dehydrogenase, and increases in inflammatory cells, total protein, and collagen. Histological lesions produced by Cu-Zn were atrophy of the nasal olfactory epithelium and hyperplasia of goblet cells in the respiratory epithelium, focal necrotizing alveolitis, alveolar macrophage hyperplasia, and goblet cell hyperplasia of bronchial and bronchiolar epithelium. The inhaled Cu-Zn alloy caused exposure-related inflammatory and cytotoxic responses in the respiratory tract, but the inhaled Cu-Zn cleared rapidly and the responses largely resolved after cessation of exposures.

9520 **(AD-A—199269/2/XAB) Correlation of lethal concentrations of heavy metals with tissue levels of earthworms. Final report.** Gal, J.Y.; Bouche, M.B. (Montpellier-2 Univ., 34 (France)). Aug 1988. 77p. NTIS, PC A05/MF A01.

Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

The objectives of this research are: To establish the LC50 of the heavy metals cadmium, copper, arsenic, and mercury as well as a Cu/Cd mixture in a ratio equal to LC50 Cd/LC50 Cu, employing a chemically defined medium such as Aristol; To improve procedures for heavy-metal bioavailability studies in the field; To improve/develop test procedures using a chemically defined medium and food in 28-day uptake studies; To analyze the tissues of the surviving test earthworms as well as those from media of lesser concentrations, blanks, and background worm stock; To relate the LC50 concentrations of contaminants with the tissue-contaminant levels in the earthworms utilized in the toxicity test; and To develop first-generation interpretations relating soil-contaminant levels and bioavailability, and to interpret the fate and transport of heavy-metal contaminants.

9521 **(ADRP—8702) The effects of acid deposition on forests.** Mayo, J.M. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Feb 1987. 81p. (MICROLOG—88-00579). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Acid deposition is a real phenomenon in Alberta; forests are being affected near point sources such as sour gas plants and oil sands extraction plants. Some soils are also potentially susceptible to acid deposition impacts. Forest decline, as reviewed in this report, is seen to result from direct, indirect, and integrative effects of acid deposition. Direct effects include ozone causing damage of membranes and inhibition of photosynthesis, sulfur dioxide causing stomatal closure and reduction of photosynthesis and chlorophyll, and possible cuticular damage and nutrient leaching from leaves due to acid deposition. Indirect effects due to soil acidification include base cation leaching and increased availability of potentially toxic Al and Mn, reduced nitrogen fixation because of inhibition of plant-bacterium symbiosis, decreased decomposition, and reduced nitrification. Land use changes and secondary succession have been proposed as major causes of soil acidification. It has also been proposed that fertilization, particularly nitrogen fertilization by nitrogen oxides and ammonia, may have stimulated forest growth leading to imbalances in other nutrients. It seems likely that some combination of these various effects will prove to be the cause of forest decline in different situations and that there will not be one general cause. The effects of acid deposition may be very site specific, requiring different mitigative treatments. The combined effects of acid deposition and forest harvest have been studied and it appears that the recent practice of whole-tree short-rotation harvest, plus the potential for acid leaching, may prove very damaging to forest survival. 242 refs., 4 figs., 13 tabs.

9522 **(ADRP—8702) The effects of acidic deposition on Alberta agriculture. A review.** Torn, M.S.; Degrange, J.E.; Shinn, J.H. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Feb 1987. 191p. (MICROLOG—88-00578). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report reviews current scientific literature on the effects of acidic precipitation, SO/sub 2/, NO/sub x/, ozone and H/sub 2/S on Alberta agricultural production. Sources for these pollutants are the petroleum industry and fossil fuel combustion. Reviews are presented of the effects of acidic precipitation, gaseous air pollution, and mixtures of pollutants, and the effects of acid deposition on plant-soil interactions and on plant-symbiont interactions. For both economic and environmental concerns, effects on plant growth, yield, and reproduction due to acid deposition are the most important responses. In 14 out of 19 species reviewed, exposure to simulated acidic precipitation resulted in reduced yields; in general, dicots were more likely to show inhibited growth than monocots. Little evidence for a linear dose response function suggests that acidic wet deposition may have a combination of competing effects on plant growth. Gaseous pollutants were seen to have different effects, depending on concentration and plant sensitivity, with sulfur and nitrogen oxides, for example, able to increase growth in plants grown in soils deficient in S or N. Interactions between pollutant types can be synergistic, additive, and antagonistic, and plants may also become sensitized or hardened to a pollutant by previous exposure to a different pollutant. Plant-soil interactions due to soil acidity are more affected by soil management practices than by acid deposition in Alberta. Acidic deposition may affect plant-symbiont interactions through impact on the plant, symbiont, or both. 325 refs., 1 fig., 39 tabs.

**9523 (ADRP—8702) An analysis of numerical models of air pollutant exposure and vegetation response.** Sagar, V.K.; Kickert, R.N. (Acid Deposition Research Program, Calgary, Alberta (Canada)). Feb 1987. 119p. (MICROLOG—88-00580). Acid Deposition Research Program, 150 Sixth Ave. SW, Suite 3800, Calgary, Alta., Canada T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A number of empirical and mechanistic models are presently available to examine the relationship between air pollution stress and plant response. The data collected often dictate the type of model developed or applied, while specifying a given model's use at the outset will influence experimentation. In air pollution research, it is common to find these steps treated separately, leading to confusion and conflict between the model's biological validity and its mathematical representation. Model development includes response planes, each representing the potential impact of air pollution at a defined plant development stage, the number of planes depending on whether the exposures are short or long term. Each plane will differ according to the response of the plant. Much of the literature on air pollution impacts has not been able to account for this differential response, and it is questionable whether whole-season, dose-response functions commonly used have any interpretive value. A meaningful approach would have to be free of the influence of the non-normal distribution of pollutant concentration occurrences. Ecological effects assessed using either model type will have a degree of uncertainty associated with the quality of data used in the modeling. Empirical regression models are mainly plot-level models, while explanatory-simultation models are mainly process-level models. The possibility of incurring a scale error, when applying a model at a level other than that from which it is derived, is one of the most critical issues facing air pollution researchers; any policy formulated on regional impact assesment must acknowledge that uncertainty. 92 refs., 3 figs., 10 tabs.

**9524 (ANL/EES-TM—359) Chemical Stockpile Disposal Program: Review and comment on the phase 1 environmental report for the Tooele Army Depot, Tooele, Utah.** Krummel, J.R.; Policastro, A.J.; Olshansky, S.J.; McGinnis, L.D.; Baldwin, T.E. (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number TI89004610/JAW.

An independent review is presented of the US Army phase I environmental report for the Tooele Army Depot (TEAD) in Utah. The phase I report reexamines site-specific data, recommends the scope and content of a phase II study, and addresses concerns that the final programmatic environmental impact statement (FPEIS) is too generic for site-specific decision making. The phase I analysis is based on the site-specific data needed to support the US Army's assessment methodology. The reviewers examined whether the phase I report is adequate, whether new data should be evaluated, and whether any new data would change the environmentally preferred alternative for disposing of unitary chemical agents and munitions proposed to be implemented at specific sites, as presented in the FPEIS. The major concerns identified relate to the use of generic, rather than site-specific, scenarios when modeling the transport and fate of accidentally released chemical agents and an error in the FPEIS in locating the disposal site for the population analysis. In addition, many of the site-specific data presented in the phase I report are not germane to the assessment methodology used in the FPEIS, but will be needed for the phase II site-specific EIS. Although additional analysis was found to be needed in the site-specific EIS to validate some of the air quality and meteorological conclusions presented for the proposed facility in the FPEIS and phase I report, none of these additional analyses is expected to significantly affect the decision for on-site incineration of the unitary chemical agents and munitions stockpiled at TEAD.

**9525 (CONF-870524—5) Water chlorination: An enigma for modern-day environmental chemists.** Johnson, J.D.; Jolley, R.L. (North Carolina Univ., Chapel Hill (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. (CONF-870524—5). NTIS, PC A02/MF A01. Order Number DE89002323/JAW.

From 6. conference on water chlorination: environmental impact and health effects; Oak Ridge, TN, USA (3 May 1987).

The challenge of modern-day water chlorination is to reap the benefits of chlorine's excellent disinfection efficacy while minimizing its environmental impacts and byproduct toxicity. Chemists, biologists, and engineers need to work together to identify, quantify, and use most effectively the disinfectant forms of chlorine to maximize disinfection, while at the same time they also need to identify, quantify, and minimize the toxic forms of by-products produced by chlorine's reactions with the organic compounds found in water. To the extent that this is possible, we can enjoy the benefits of chlorine disinfection and minimize the human and environmental impacts of chlorination by-products. 22 refs.

**9526 (CRIE-U—87068) Biological effects of combined exposure to fly ash and nitrogen dioxide (part 1). Effects of acute nitrogen dioxide exposure on golden hamsters.** Nishimura, Izumi; Negishi, Tadashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755728/JAW.

As a part of studies on biological effects of combined exposure to coal fly ash and the air pollution gases, an experiment on high concentration $NO_2$ exposure on golden hamsters, that seems to be very sensitive to $NO_2$, was carried out. Male golden hamsters were exposed to 14ppm $NO_2$, which is half of the median lethal concentration, daily 20 hours for 14 days. No acute death was observed during the exposure, but increase in relative lung wet weight to body weight of hamsters was shown, and pulmonary edema was suggested to be developed. The amount of lipid peroxides in lung kept increased gradually with exposure time. The amount of glutathione, which protect a living body from oxidation by $NO_2$, slightly decreased at the beginning of exposure then increased. It was reported that when golden hamsters were exposed to low concentration, the activity of antioxidation was higher than that of other laboratory animals. Meanwhile, at high concentration of $NO_2$ exposure, peroxidative damage is more severe than other laboratory animals such as rats. (16 figs, 1 tab, 23 refs)

**9527 (DOE/ER/60592—T1) Particle deposition in human and canine tracheobronchial casts: Annual progress report.** Cohen, B.S. (New York Univ., NY (USA). Medical Center). 1 Dec 1988. Contract FG02-87ER60592. 16p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004054/JAW.

The objective of this work is to measure deposition patterns and efficiencies of aerosol particles within realistic, single-pathway, physical models of the tracheobronchial airways of humans and experimental animals over a range of particle sizes for a variety of respiratory modes and rates. This will provide data needed to assess the effect of particle size, breathing pattern and respiratory tract morphology on the dose to the critical cells of the bronchial epithelium. Measurements completed in the first grant year documented airflow distribution in casts of the human and canine tracheobronchial trees for both constant and pulsatile inspiratory flow. Inertance was demonstrated to carry more of the flow to lower lobes at higher inspiratory flowrates. Current measurements determined distribution of flow during exhalation for different total flowrates. The measured airflow resistance is substantially greater during exhalation. The magnitude of each effect differs for the canine cast compared with the human cast. This suggests that basic differences in airway branching pattern will contribute to different mass transfer patterns in the two species. 10 refs., 1 fig., 4 tabs.

**9528 (EUR—10704) Biological indicators for the assessment of human exposure to industrial chemicals Alkyl lead compounds. Dimethylformamide. Mercury.** Alessio, L.; Berlin, A.; Boni, M.; Roi, R. (eds.) (Commission of the European Communities, Ispra (Italy). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1987. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756029/JAW.

Biological monitoring is one of the most promising tools for performing an effective programme of prevention from the potentially toxic effects of chemicals in an occupational environment. Its most interesting feature consists in the possibility of predicting toxicological diseases at a very early stage by means of measurement of

indicators of dose and effects. For industrial chemicals such as mercury, alkyl lead, DMF and pesticides a description of the types and characteristics of indicators is given. The limitation and difficulties inherent in biological monitoring are analyzed, indicating the goals for further research in this field.

9529 (KFK-PEF—35-Vol.1, pp 1-26) **Review of the current status of soil investigations in connection with the new-type forest diseases.** Rehfuess, K.E. (Muenchen Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

A significant role of soil or soil properties as one cause of new type-forest diseases in Central Europe until now has been identified only for the so-called 'high altitude' disease of Norway spruce. With regard to other disease types either the contribution of soil-induced stress is unclear or the 'new type' character of the disease is in question. Several field inventories and some experiments give evidence that a high input of protons, sulfate and nitrate may decrease the pH value of certain soil types in certain landscapes, enhance the leaching of Ca, Mg and K from the soils and may also release Al and heavy metals into the soil solution. The synchronization of different disease types during the period 1980-1985 on the contrary is caused by large-scale weather stress events like dry periods or frost phenomena or combinations of such events. Infertile soils, inadequate nutrition, pollution and atmospheric deposition or pathogens are not general, but regional or disease-type specific stress factors, whereever they act with large intensity.

9530 (KFK-PEF—35-Vol.1, pp 103-111) **Influence of fertilization of nitrogen on the mycorrhiza-system of spruce.** Haug, I.; Kottke, I.; Oberwinkler, F. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Biologie 1 - Spezielle Botanik, Mykologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

A laboratory experiment was carried out with different nitrogen forms (NH/sub 4//sup +/, NO/sub 3//sup -/) and different nitrogen levels. For each nitrogen form three concentrations were chosen. Spruce seedlings inoculated with Pisolithus tinctorius or Amanita muscaria were placed in growth chambers with the different nitrogen-variants. After 7 weeks most seedlings in the high ammonium concentration were dead. There was no significant difference in the growth rate of the roots with exception of the high ammonium variant. The greatest total root length was reached in the low variants, also the highest amount of short roots. The shoot/root-ratio is positively correlated with the ammonium concentration. With increasing nitrate concentrations, the shoot/root-ratio also increases, but the differences are not significant. In the low and middle variants, there were well developed mycorrhizae with a hyphal mantle and a Hartig net. The greatest amount of mycorrhizae was found in the low nitrate variant. Light microscopic investigations revealed no differences in the structure of the mycorrhizae from the different variants. Quantitative analyses are not possible with the used method.

9531 (KFK-PEF—35-Vol.1, pp 113-121) **Influence of fertilization in forests on the fructification of mycorrhiza fungi.** Mueller, C.; Oberwinkler, F. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Biologie 1 - Spezielle Botanik, Mykologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Mycorrhizal basidiocarps have been inventoried on old fertilization test plots in the northern Black Forest over the last three years. First results are available and will be presented and interpreted. Fertilization took place in 1953, 1954, 1955 and 1966. The fertilizers which had been used were Kalkammonsalpeter (Ca(NO/sub 3/))/sub 2/, kohlensauerer Kalk (CaCO/sub 3/) and Thomasphosphat (P). The approximately 100 years old spruce trees (P. abies) were growing on a sandy, clayey and stony acid podsolic brownearth partly covered by a 10 cm thick organic layer. In 1985, 1986 and 1987 inventories of the mycorrhizal basidiocarps took place. Very clear differences were found in the numbers of species and between the fertilized and nonfertilized plots. The collected data indicate in several cases that the status of decomposition and the thickness of the humus layers are very important in connection with quantitative differences in fruitbody production in the different plots.

9532 (KFK-PEF—35-Vol.1, pp 163-171) **Content of fructose 2,6-bisphosphate as indicator for specific changes of carbohydrate metabolism in damaged spruce needles.** Einig, W.; Hampp, R. (Tuebingen Univ. (Germany, F.R.). Abt. Biochemie der Pflanzen). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

In relation to age and degree of damage, lyophilized spruce needles (Picea abies) were analyzed for intermediates of carbohydrate metabolism: Starch, sucrose, glucose, fructose, fructose 6-phosphate (F6P), triose phosphates, 3-phosphoglyceric acid, and fructose 2.6-bisphosphate (F26BP). With the exception of sucrose current-year needles showed higher levels of metabolites in June when compared to July. This difference was especially significant for F6P and F26BP. A comparison between healthy and diseased needles showed, when related to chlorophyll, decreased levels of starch, a slightly increased amount of sucrose but high levels of F26BP. Thus F26BP could constitute an important biochemical marker for impaired carbon allocation.

9533 (KFK-PEF—35-Vol.1, pp 185-190) **Chlorophyll fluorescence signatures of healthy and damaged spruce trees.** Lichtenthaler, H.K.; Rinderle, U. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Botanisches Inst. 2). Apr 1988. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The chlorophyll fluorescence signatures of the needles of healthy and damaged spruce trees in the northern Black Forest were determined by using a self-constructed portable field fluorometer as well as the PAM-fluorometer. These new instruments allowed to measure the red laser-induced chlorophyll fluorescence induction kinetics (Kautsky effect) at 690 and 730 nm, the determination of the Rfd-values (Rfd 690 and Rfd 730) as vitality index, and the stress adaptation index A/sub p/ as well as the photochemical Q-quenching and the non-photochemical E-quenching of the spruce needles. The difference in the fluorescence signatures and photosynthetic activity between the needles of healthy and damaged trees are presented. In the needles of the damaged trees particularly the values of the non-photochemical E-quenching are augmented, whereas the capacity for photosynthesis and the reoxidation of Q/sub A/ are strongly reduced.

9534 (KFK-PEF—35-Vol.1, pp 209-218) **Histological and histochemical investigations on the dynamics of nutrients in forest trees in relation to the 'new-type forest decline'.** Fink, S. (Freiburg Univ. (Germany, F.R.). Inst. fuer Forstbotanik und Holzbiologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Needles from healthy, diseased, and experimentally treated Norway spruces and silver firs were investigated histologically and histochemically. The results confirmed prior findings that mineral deficiencies (Mg, Ca, K) induce a premature collapse of sieve cells within the vascular bundle of the needles. The possible cause of

these changes is discussed in relation to the significance of these cations for phloem loading and assimilate transport. Further considering the role of the phloem for the secondary retranslocation of mobile nutrients, the complex interaction between nutrient supply and phloem function in the development of different damage symptoms under various stresses is discussed.

9535 (KFK-PEF—35-Vol.1, pp 231-243) **Distribution of heavy metals in forest trees from geogenicly differently polluted sites.** Trueby, P.; Zoettl, H.W. (Freiburg Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrungslehre). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

The investigation is focussed on separating heavy metal uptake from soil or from atmospheric deposition and on demonstrating internal pathways of redistribution within the trees. A pair of silver fir and a pair of douglas fir were selected from heavily polluted mining spoils, respectively, from gneiss-brown-earths. Lead is already retained in the outer root bark. However, depending upon the supply in the soil considerable amounts are taken up by the roots and are accumulated in the trunk. Due to internal redistributions lead is preferably accumulated in sapwood - heartwood boundary. It seems to be a process of detoxication. While zinc is also retained in the outer root bark, cadmium is accumulated in the inner bark. The trees respond to a higher amount of heavy metals in the soil with an internal redistribution into the older sapwood and older needles. No apparent damage is observed. A reconstruction of the air pollution history of a site from the distribution of heavy metals in the stemwood is not very promising due to the above described tree internal redistributions.

9536 (KFK-PEF—35-Vol.1, pp 255-264) **Investigations on spruce-trees in a diseased forest area with exclusion of gaseous pollutants in open-top chambers.** Seufert, G.; Arndt, U. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

An experimental field with a continuously working monitoring station nearby has been established. Here 15 year old, naturally rooting and healthy looking spruce trees are growing in open-top-chambers since summer 1986 (one tree per chamber). Each of the 4 trees with a mean height of 6 m are kept in chambers with charcoal-filtered air, with ambient air, and serve as an ambient outside-control, to look at effects of gaseous pollutants. As in the years before, we are concentrating on description of climatic/edaphic site conditions as well as pollutant concentration and uptake inside compared to outside the chambers. With the exception of SO/sub 2/-episodes in January/February 1987 there have been observed low SO/sub 2/-, NO/sub 2/- and ozone-concentrations compared to the years before because of weather conditions. For effect research by different groups five needle samplings have been undertaken through the year. The research concept will be described, as it was confirmed at the last meeting in January of all groups involved in the program.

9537 (KFK-PEF—35-Vol.1, pp 265-275) **Ecophysiological measurements on pollutant stressed fir and spruce trees in the open top chamber facilities at Hohenheim.** Schweizer, B.; Arndt, U. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Ecophysiological investigations concerning the CO/sub 2// H/sub 2/O-gas exchange of air pollutant stressed trees were continued in 1987. Silver fir and spruce trees are stressed under controlled conditions with realistic concentrations of either ozone, sulphur dioxide and acid rain or a combination of all in open top chambers on lysimeters since 4 years. The main emphasis of the measurements was put on the determination of photosynthetic activity at different CO/sub 2/-concentrations in the environment of the needles (natural air conditions/saturated CO/sub 2/-concentrations). From the data different parameters characterizing the photosynthetic activity were calculated, for example the light use efficiency and the maximum photosynthetic capacity. The measurements were performed in a temperature- and humidity controlled cuvette with a gas-mixing device connected in series in front of the system. Coinciding in time determination of transpiration rate and leaf conductance was carried out using a portable steady state porometer. In addition the leaf water potential and osmotic potential were determined.

9538 (KFK-PEF—35-Vol.1, pp 277-285) **Biochemical and physiological investigations to detect effects of air pollutants on spruce in open-top chambers.** Manderscheid, R.; Bender, J.; Jaeger, H.J. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.). Inst. fuer Produktions- und Oekotoxikologie). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Some biochemical and physiological parameters of 15 years old spruce trees growing in a diseased forest area ('Edelmannshof', a location in the Swabian-Frankonian-Forest, FRG) in open-top chambers with charcoal-filtered and nonfiltered air are studied. According to the different kinds of emission - acidic air pollution (SO/sub 2/ and NO/sub x/) and photochemical oxidants - some metabolic parameters, which are known to react specifically to each tpye of air pollution, are determined. The diagnosis will be confirmed by correlation of the metabolic parameters with the air pollution data. First measurements indicate a slightly higher glutathione and ascorbate content in the polluted needles.

9539 (KFK-PEF—35-Vol.1, pp 287-296) **Feasibility study of experiments with open-top chambers to assess effects of various air pollutants on health and growth of forest trees.** Kenk, G.; Boehm, G.; Hungar, U. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Starting in Nov. 1986, two open-top chambers are tested at an high elevation site (850 m above sea level) of the Southern Black Forest, FRG. In order to check climatic effects during one year, meteorological data were recorded continuously from Nov. 1986 till Oct. 1987 and a preliminary analysis was made. Results are given for air temperature, soil temperature, humidity, radiation and CO/sub 2/-concentration. Remarkable temperature differences were measured on warm and sunny days. The annual mean temperature inside the chambers was 1,5-2/sup 0/C higher. This difference corresponds to chamber temperatures on cloudy or rainy days. Inside and outside temperatures were never identical. The radiation inside the chambers was also considerably reduced. Days of high sun intensity brought losses of PhAR-radiation (400-700 nm) of 50-75%. The deficit of total radiation (290-3000 nm) varied between 20% (without screening) and 60% (with screening). Subsequently, the climatic effects in consideration of plant physiological influences will be discussed.

9540 (KFK-PEF—35-Vol.1, pp 297-310) **Progeny test of Norway spruce stands in the Black Forest (areas of origin 840 08 and 840 09) aiming at: 1. Improvement of emmission tolerance, 2. conservation of genetic resources of damaged stands in high altitudes ('genetic bank').** Geldbach, J.; Schroeder, S. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.). Abt. Botanik und Standortskunde). Apr 1988. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88755982/JAW. (CONF-8803158—Vol.1).

From 4. annual report of the Research Programme for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (8 Mar 1988).

Progeny test of Norway spruce stands in the Black Forest (areas of origin 840 08 and 840 09) aiming at: (1) Improvement of emmission tolerance. (2) Conservation of genetic resources of damaged stands in high altitudes ('genetic bank'). The impacts of forest damage caused by acid rain are presented from a genetic view. As acute and urgent measures to be taken by forest genetics are featured the following: Conservation of genetic diversity of forest tree populations. Scientific support of seed supply activities concerning best adapted material for the affected sites. The programme will be accompanied by isozyme analysis of the different progenies. This may contribute to improve the knowledge about genetic structures and to detect relations between genetic potentials and emmission tolerance.

9541 **(LA—11437-MS) Preliminary toxicological study of yttrium barium copper oxide.** London, J.E. (Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004541/JAW.

The calculated acute oral $LD_{50}$[30] (lethal dose for 50% of the animals occurring within 30 days after compound administration) value for yttrium barium copper oxide was 3000 mg/kg in rats. According to classical guidelines, this compound would be considered slightly toxic to moderately toxic for rats. Mice had a 16% death rate at the 5-g/kg-dose level. Skin application studies in rabbits demonstrated the material to be a moderate irritant. The eye study in rabbits disclosed the compound to be an irritant. The sensitization study in guinea pigs did show yttrium barium copper oxide to have potential sensitizing properties. 4 refs., 3 tabs.

9542 **(LA—11461-MS) A toxicological study of 1,2,4-triazole-5-one.** London, J. (Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004070/JAW.

The acute oral $LD_{50}$ values for 1,2,4-triazole-5-one (TO) are greater than 5g/kg. According to classical guidelines, the material would be considered only slightly toxic or practically nontoxic in both rats and mice. The sensitization study in the guinea pig did not show TO to have potential sensitizing effects. Skin application studies on the rabbit demonstrated it was cutaneously nonirritating. This material was also nonirritating in the rabbit eye application studies. 4 refs., 1 tab.

9543 **(NP—9770174) Effects of forest decline on water economy with special regard to water quality. Literature study.** Benecke, P.; Linkersdoerfer, S.; Thoenniessen, J. (Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung; Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.) Inst. fuer Wasser- und Abfallwirtschaft; Ministerium fuer Ernaehrung, Landwirtschaft, Umwelt und Forsten Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1986. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770174/JAW.

Possible effects of forest decline on water quality are examined. The most important factor for it is the change of soil chemistry, caused by deposition of acid rain. Possible consequences for both, the forest ecosystem and the water quality, are explained.

9544 **(ORNL/M—634) Asbestos: Regulatory status and possible future changes affecting DOE activities.** Sigmon, C.F.; Eddlemon, G.K. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003800/JAW.

The purpose of the following discussion is to focus on potential areas of change in asbestos regulation that might affect DOE facilities and to present sufficient background on the existing regulations to place these potential changes in perspective. Because building demolitions and renovations as well as replacement of deteriorating asbestos are common activities at DOE facilities, asbestos regulation and upcoming changes are particularly important to DOE.

9545 **(PB—88-244298/XAB) Review of a draft addendum to the health-assessment document for perchloroethylene. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 27 Jan 1987. 14p. (SAB/EHC—87/018). NTIS, PC A03/MF A01.

See also PB—85-249704.

The Committee previously reviewed a draft Health Assessment Document on May 9-20, 1984 and an Addendum is desirable because of newly available data, primarily an inhalation bioassay of rodents by the National Toxicology Program. The Subcommittee believes it is reasonable to describe the weight of the epidemiological evidence in humans as conforming to the EPA guideline for carcinogen risk-assessment definition of inadequate. The Subcommittee concluded that the animal evidence of carcinogenicity is limited because of positive results in only one strain of mouse of a type of tumor that is common and difficult to interpret. Therefore, the Subcommittee concluded that perchloroethylene belongs in the overall weight-of-the-evidence category C (possible human carcinogen).

9546 **(PB—88-246178/XAB) Health and Environmental Effects Profile for phthalic anhydride.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Aug 1986. 67p. (EPA—600/X-86/242). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for phthalic anhydride was prepared to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human-health, aquatic-life, and environmental effects of hazardous-waste constituents. Phthalic anhydride has been determined to be a systemic toxicant. The daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effect during a lifetime, for phthalic anhydride is 7.5 mg/kg/day for oral exposure. The Reportable Quantity (RQ) value for phthalic anhydride is 1000.

9547 **(PB—88-246186/XAB) Health and Environmental Effects Profile for xylenes (o-, m-, p-).** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Aug 1986. 198p. (EPA—600/X-86/216). NTIS, PC A09/MF A01.

The Health and Environmental Effects Profile for xylenes (o-, m-, p-) was prepared to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human-health, aquatic-life, and environmental effects of hazardous-waste constituents. Xylenes were determined to be systemic toxicants. The daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effect during a lifetime, for xylenes is 1.8 mg/kg/day for oral exposure. The Reportable Quantity (RQ) value for xylenes is 1000.

**9548 (PB—88-247606/XAB) Elemental mercury exposure: correlation of urine mercury indices with ulnar nerve conduction studies.** Levine, S.P.; Cavender, G.D.; Langolf, G.D.; Albers, J.W. (Michigan Univ., Ann Arbor (USA)). 1988. 18p. NTIS, PC A03/MF A01.

An electrophysiological evaluation was made of the ulnar nerve in 18 men who were exposed to elemental mercury vapor in the course of their jobs at a mercury-cell chlorine plant. The men averaged 31 years of age, ranging from 19 to 56. Urinary mercury levels were available for three years prior to the evaluation of the ulnar nerve. Abnormal nerve conduction studies were obtained in five subjects, with three having prolonged sensory distal latency, one having prolonged motor distal letency and one having both prolonged motor and sensory distal latencies with a low normal SNAP amplitude. Over half of the mercury levels were significantly higher in this abnormal group. The highest correlation obstained was between sensory latency and the number of months urine mercury exceeded 0.50 milligrams/liter. The authors conclude that exposure to elemental mercury can affect both motor and sensory peripheral nerve conduction and that the degree of involvement can be related to time-integrated urine mercury levels.

**9549 (PB—88-248018/XAB) Studies in zinc metabolism. IV. Interactions of Zn and Cd. Annual report.** Murthy, L.; Petering, H.G. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1971. 9p. NTIS, PC A02/MF A01.

The effect of orally administered cadmium on zinc was studied in rats given cadmium at zinc-to-cadmium ratios of 1:5, 1:2, or 4:1. The effect of carbohydrate source on zinc and cadmium response was also studied. Growth was restricted only when the zinc intake was low in comparison to cadmium. Rats fed chow containing zinc and copper at ten times the optimal dietary levels were not affected by the cadmium dosing. Serum cholesterol and phospholipid levels were somewhat diminished with increased zinc. Cadmium concentrated mainly in the kidney, liver, and pancreas with zinc showing a protective effect. The effect of cadmium on liver zinc content was greater when corn starch was fed. No appreciable increase of cadmium was noted in the testes or heart and very little localization in the lung or pancreas. Organ levels of copper and zinc were altered as a result of cadmium exposure. Effects were more pronounced at low levels of zinc nutrition.

**9550 (PB—88-248307/XAB) Biologic activity of lipid-coated quartz dust. Progress report.** Tuma, J. (Industrial Health Foundation, Inc., Pittsburgh, PA (USA)). 3 Mar 1971. 6p. NTIS, PC A02/MF A01.

The biological activity of quartz dust coated with endogenous lipids was investigated. The theory under study was that the lipoidic coating would render the quartz particles nonwettable, and therefore biologically inert. Lipid coated and uncoated dust was dispersed in water and injected into rats intratracheally. The animals were sacrificed 2 days, 6 months or 10 months following injection. No significant differences were found in the content of silica and hydroxyproline in the lungs of rats injected with lipid coated or uncoated dust. Lymph-node silica content was also similar between the two treatment groups. The quality or quantity of the silicotic nodulations induced by the lipid coated silica and by the noncoated silica were similar. The authors concluded that the treatment of quartz dust with endogenous lipids did nothing to reduce the biological activity of this mineral in its ability to produce silicotic nodulations and collagen in rat lungs. The clearing of silica dust from the lungs was also not changed by the treatment.

**9551 (PB—88-248315/XAB) Surgery during pregnancy and fetal outcome.** Brodsky, J.B.; Cohen, E.N.; Brown, B.W.; Wu, M.L.; Whitcher, C. (Stanford Univ., CA (USA). Dept. of Anesthesia). 1988. 15p. NTIS, PC A03/MF A01.

Information was sought on wives of dentists or female dental assistants who underwent surgery during their pregnancies to determine the effects of anesthesia and surgery on fetal outcome. Occupational exposure to inhalation anesthetics either directly (dental assistants) or indirectly (wives of exposed male dentists) was associated with a significant increase in spontaneous abortion rate over a comparison group during both trimesters. Anesthesia for surgery was also associated with increased fetal loss when administered during the first or second trimesters. The number of congenital abormalities in children born to women who had surgery during pregnancy was not increased. For women surgically exposed to anesthetics and occupationally exposed as well, either directly or indirectly, the risk of spontaneous abortion increased almost threefold above control lvels. The authors conclude that elective surgery should be deferred during early pregnanacy to minimize potential fetal loss.

**9552 (PB—88-248331/XAB) Cadmium in tobacco and its fate during smoking.** Petering, H.G.; Menden, E.E.; Michael, L.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1988. 8p. NTIS, PC A02/MF A01.

Using a smoking machine, reference cigarettes, a commercial brand of nonfilter 85-millimeter cigarettes, a medium-priced cigar, and a popular brand of pipe tobacco, both wet-ashing and dry-ashing procedures were carried out to determine the cadmium content to which smokers were being exposed. Cigarettes varied from 1.31 to 1.28 micrograms (microg) of cadmium per cigarette, which corresponded to 1.17 to 1.62 microg per gram (g) of cigarette. For cigar tobacco a total of 1.86 microg/g was found and in pipe tobacco the content was 0.93 microg/g. Only 6 to 7% of the cadmium in the smoked portion of the cigarette appeared in the tar, while the unsmoked butts were enriched with 10 to 27% of the cadmium of the smoked portions. The authors suggest that the remaining cadmium, 50 to 55%, is lost in the sidestream during smoking and between puffs. This indicated that not only is the one smoking at risk from cadmium exposure, but so are the others present in the vicinity.

**9553 (PB—88-248380/XAB) Asbestos-induced intrathoracic tissue reactions.** Gross, P.; Harley, R.A. (Industrial Health Foundation, Inc., Pittsburgh, PA (USA)). 1988. 20p. NTIS, PC A03/MF A01.

Research tested the trace metal hypothesis for the development of asbestos-related lung cancer while also documenting the occurrence of malignant intrathoracic tumors resulting following intrathoracic injections of different types of asbestos in rats and hamsters. Rats and hamsters were injected with amosite, chrysotile or crocidolite prepared by one of five methods. Animals injected with dusts that had been heated (dust treated or untreated with aqua-regia) demonstrated a low tumor incidence, around 2%, whereas animals treated with dusts which had not been heated or treated demonstrated a 21% tumor rate in hamsters and 33% in mice. The incidence of tumors in both species was least with chrysotile. The other two types of asbestos caused similar incidences of tumors in rats, but in hamsters amosite caused a higher incidence of tumors than crocidolite.

**9554 (PB—88-250246/XAB) Comparative mesothelioma induction in rats by asbestos and non-asbestos mineral fibers: possible correlation with human-exposure data.** Coffin, D.L.; Palekar, L.D.; Cook, P.M.; Creason, J.P. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Aug 1988. 20p. NTIS, PC A03/MF A01.

Fischer 344 rats were injected intrapleurally with chrysotile and crocidolite asbestos, erionite and attapulgite and observed for their entire lifespan. Detailed analysis of the number per unit mass of the various size categories of the fibers for each mineral species was determined and the dose in terms of actual number of mineral fibers computed. Data for survival time and number of tumors induced suggests that in addition to the length/width factors, an additional property plays a role in fiber potency. Analysis of the available data from the literature, where populations were known to have been exposed to pure mineral fibers, indicates that ranking for human mesothelioma incidence appears congruent with the rat intrapleural data.

**9555 (PB—88-250329/XAB) Human lung-cancer risks due to complex organic mixtures of combustion emissions.** Mumford, J.L.; He, X.; Chapman, R.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Sep 1988. 30p. (EPA—600/D-88/197). NTIS, PC A03/MF A01.

The study of Xuan Wei fuel use and lung cancer mortality and also the interim case-control study suggested an association between domestic smoky coal use and Xuan Wei lung cancer. The collaborative studies of physical characterization, chemical analysis, and toxicology further substantiated this linkage. The Xuan Wei residents who used smoky coal inhaled extremely high concentrations of most submicron-sized particles, which were composed mostly of organic compounds (72%), including mutagenic and carcinogenic organic compounds (especially in the aromatic and polar fractions). In comparison to wood and smokeless coal combustion emissions, the organic extracts of smoky coal emission particles showed a much higher activity of genotoxicity and carcinogenicity. The results all point to a strong etiological link between the complex organic mixtures from smoky coal emissions and Xuan Wei lung cancer.

9556 **(PB—88-250394/XAB) Study of the biological activity of erionite in relation to its chemical and structural characteristics.** Coffin, D.L.; Peters, S.E.; Palekar, L.D.; Stahel, E.P. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Aug 1988. 24p. NTIS, PC A03/MF A01.

Fibrous erionite appears to have many times the mesothelioma induction potential of asbestos. A member of a class of minerals termed zeolites, it differs markedly from asbestos in many physico-chemical characteristics. For preliminary biological studies, experiments were based on the hypothesis that the active surface sites within the internal voids are contributory to the unusual activity of this mineral. Two approaches were followed: encapsulation of isopentane into the internal spaces and exchange of cations, $Cr^{3+}$ and $Ca^{2+}$. Preliminary data suggests that toxicity to V79 cells was altered by these processes. The implication of the intense tumorigenesis of erionite may be of great basic importance in contributing data for mechanistic studies such as the illumination of a second variable in tumor induction.

9557 **(PB—88-251178/XAB) Health and Environmental Effects Profile for 2,4-toluenediamine.** (Syracuse Research Corp., Cincinnati, OH (USA)). May 1986. 107p. NTIS, PC A06/MF A01.

The Health and Environmental Effects Profile for 2,4-toluenediamine was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. 2,4-Toluenediamine has been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for 2,4-toluenediamine is 3.2 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value for 2,4-toluenediamine is 100.

9558 **(PB—88-251202/XAB) Health and Environmental Effects Profile for ethylbenzene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1986. 120p. (EPA—600/X-86/145). NTIS, PC A06/MF A01.

The Health and Environmental Effects Profile for ethylbenzene was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human-health, aquatic-life and environmental efects of hazardous-waste constituents. Ethylbenzene has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), for ethylbenzene is 0.097 mg/kg/day for oral exposure. The Reportable Quantity (RQ) value for ethylbenzene is 1000.

9559 **(PB—88-251244/XAB) Health and Environmental Effects Profile for maleic anhydride.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1986. 70p. (EPA—600/X-86/196). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for maleic anhydride was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human-health, aquatic-life, and environmental effects of hazardous-waste constituents. Maleic anhydride has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), for maleic anhydride is 0.10 mg/kg/day for oral exposure. The Reportable Quantity (RQ) value for maleic anhydride is 100.

9560 **(PB—88-251749/XAB) Effects of ozone and soil-water deficit on roots and shoots of field-grown soybeans.** Heggestad, H.E.; Anderson, E.L.; Gish, T.J.; Lee, E.H. (Agricultural Research Service, Beltsville, MD (USA). Plant Stress Lab.). 1988. 22p. NTIS, PC A03/MF A01.

Pub. in Environmental Pollution Vol. 50, 259-278(1988).

Water-stressed and well-watered soybean (Glycine max cvs.Williams and Corsoy) plants were exposed to increasing seasonal doses of ozone ($O_3$) using open-top field chambers and ambient air plots. Chamber $O_3$ treatments included charcoal filtered (CF) air, non-filtered (NF) air, NF+0.03, NF+0.06 and NF+0.09 ul/liter $O_3$. Soil-water potentials measured at 25 and 45 cm averaged -040 M Pa and -0.05 M Pa, respectively, for the plots in the water-stressed and well-watered series. Total root length/core, root length densities, and biomasses (dry weights) were determined. In both soil moisture regimes, with both cultivars, there was a linear decrease in seed yield and top dry weight as the $O_3$ exposure dose increased.

9561 **(PB—88-252390/XAB) Neoplastic effects of vinyl chloride in mouse lung lower doses and short-term exposure, 1982.** Suzuki, Y. (Mount Sinai School of Medicine, New York. Environmental Sciences Lab.). 30 Nov 1982. 23p. NTIS, PC A03/MF A01.

See also PB—84-241660.

Effects of exposure to 1 to 600 parts per million (ppm) vinylchloride (75014) over 4 week periods were investigated in 220 male CDI-Charles-River-mice. At 12 weeks, 88.8% of those exposed to 600 ppm and 6.6% of those exposed to 300 ppm were found to have alveologenic tumors. In the 300 ppm group these were all single tumors whereas the 600 ppm group all had multiple tumors. A dose/response relationship was noted for tumor incidence as well as a dose-related latency period. Dose and the recovery period after exposure seem to be the factors that determine the incidence of multiple alveologenic tumors. Larger tumors appeared to occur in the group receiving the higher dose levels and also in animals whose recovery period was longer. Spontaneous alveologenic tumors occurred in six animals. Neoplastic cells in both the tubulopapillary and adenomatous forms of the pulmonary tumors possessed all or some of the ultrastructural characteristics of type-II alveolar cells. Other tumors included hemangiosarcomas in the subcutaneous connective tissue of the ear and the liver.

9562 **(PB—88-252614/XAB) Respiratory tract irritants: mechanisms and tolerance. Report for 1 October 1971-30 September 1981.** Alarie, Y. (Pittsburgh Univ., PA (USA). Dept. of Industrial Environmental Health Sciences). 1981. 8p. NTIS, PC A02/MF A01.

An attempt was undertaken to develop animal bioassays for the purpose of evaluating the potency of airborne chemical irritants

and predicting the safe-exposure limits or threshold-limit values (TLVs) for workers in industrial settings. A series of 11 industrial chemicals was selected to aid in developing the first bioassay. The model was then extended to include a series of weak sensory irritants and predict TLVs for these compounds. The model was then extended to include alkylbenzenes, mixtures of formaldehyde and acrolein and mixtures of acrolein and sulfur dioxide. Through a second bioassay, the possibility of pulmonary hypersensitivity was recognized by using toluene-diisocyanate as the model chemical. This model gave rise to the first demonstration of hapten specific respiratory hypersensitivity in an animal model and can be used to investigate other chemicals suspected of inducing immediate pulmonary hypersensitivity in exposed workers. To evaluate pulmonary irritation from airborne industrial chemicals a third bioassay was developed. A fourth bioassay was developed to evaluate whether airborne chemical irritants would interact with DNA in cells of the respiratory tract as well as in cells of other organs.

**9563 (PB—88-252663/XAB) Toxic mechanisms of inhaled methyl methacrylate vapor.** Tansy, M.F. (Temple Univ., Philadelphia, PA (USA)). 21 Feb 1979. 7p. NTIS, PC A02/MF A01.

Experiments were undertaken to investigate the effect of exposure to 116 parts per million (ppm) methyl methacrylate for 8 hours/day, 5 days/weeks for 3 months on mature male Sprague-Dawley-rats. Results supported the earlier findings that long-term methyl methacrylate inhalation influences blood chemistry. Earlier findings of depressed body weight, epididymal and popliteal fat pad-weight reduction were not confirmed. No effect on various gross metabolic parameters was demonstrated. There appeared to be a relationship between systematic methyl methacrylate vapor exposure and gastrointestinal motor performance. Chronic exposures were associated with frank damage to tracheal epithelial cells, including denudation of microvilli. Frank liver damage also resulted. The median lethal dose was found to be 7093 parts per million. The extent of the reduction in contractility of the small intestine was far more pronounced with ethyl-acrylate and butyl-acrylate than it was with methyl-methacrylate.

**9564 (PB—88-252689/XAB) Hair as a monitor of toxic chemicals exposure.** Jones, P.F.; Adams, S.; Baumgartner, W.A. (Aerospace Corp., Los Angeles, CA (USA). Chemistry and Physics Lab.). 31 Aug 1982. 14p. (ATR—0082-7950-1). NTIS, PC A03/MF A01.

The possibility of using hair analysis as a monitor of exposure to hydrazines and polychlorinated biphenyls (PCBs) was investigated. Two female Hartley guinea pigs injected with 0.6 milligrams (mg) of Aroclor-1254 had analyzable concentrations of the PCB in their hair. Analysis was made using glass capillary gas chromatography with an electron-capture detector. The levels ranged from 10 picograms/milligram (pg/mg) of Aroclor-1254 in washed hair to 100pg/mg in unwashed hair. Female Fischer-344 rats injected intraperitoneally with 60mg/kg unsymmetrical dimethyl hydrazine (UDMH), 10mg/kg monomethyl hydrazine (MMH) and/or 10mg/kg hydrazine did not have detectable amounts of these chemicals in their hair at 14, 30 or 42 days after injection. The hair samples did take up the hydrazines when suspended above solutions of the test compounds. The authors concluded that analyzing the PCB content of hair may be useful in providing a history of on-the-job PCB exposure.

**9565 (PB—88-870563/XAB) Dioxins: formation, transport, and deterioration. January 1970-October 1988 (Citations from the NTIS data base). Report for January 1970-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 181p. NTIS PC N01/MF N01.

Supersedes PB—88-850862.

This bibliography contains citations concerning the formation, environmental transport, and degradation of dioxins. Formation by combustion is examined. Dioxin emission monitoring studies of municipal and industrial boilers are included. Dioxin level monitoring in humans, air, soil, and water is discussed. Methods of dioxin destruction discussed include controlled combustion and ultraviolet radiation. (This updated bibliography contains 270 citations, 51 of which are new entries to the previous edition.)

**9566 (PB—89-105613/XAB) Ozone exposure increases respiratory epithelial permeability in humans (journal version).** Kehrl, H.R.; Vincent, L.M.; Kowalsky, R.J.; Horstman, D.H.; O'Neil, J.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 7p. (EPA—600/J-87/398). NTIS, PC A02/MF A01.

Pub. in American Review of Respiratory Diseases, Vol. 135, 1124-1128(1987).

After both air and ozone exposures, the permeability of the respiratory epithelium was assessed by measuring the pulmonary clearance rate of inhaled aerosolized 99mTc-labeled diethylene triamine pentacetic acid (99mTc-DTPA). Following ozone exposures sufficient to induce decrements in mechanical lung function, seven of eight young men showed increased epithelial permeability.

**9567 (PB—89-106009/XAB) Blood lead, hearing thresholds, and neurobehavioral development in children and youth (journal version).** Schwartz, J.; Otto, D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 11p. (EPA—600/J-87/434). NTIS, PC A03/MF A01.

Pub. in Archives of Environmental Health, Vol. 42, No. 2, 153-160(1987).

NHANES II audiometry data were used to confirm a previously observed link between blood lead (PbB) level and hearing threshold. Other indicators of neurological development, such as age at which a child first sat up, walked, and spoke, and the presence of speech difficulties and hyperactivity were also examined to determine if they were significantly related to lead exposure. The probability of elevated hearing thresholds at 500, 1000, 2000 and 4000 Hz increased significantly ($P<0.0001$) with increasing PbB for both ears. PbB levels were also significantly related to delays in the age at which children first sat up, walked, and spoke and to the probability that a child was hyperactive. Lead was not related to the probability of a child having a previously diagnosed speech impairment.

**9568 (PB—89-109367/XAB) Lethality and hepatotoxicity of complex waste mixtures (journal version).** Simmons, J.E.; DeMarini, D.M.; Berman, E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1988. 15p. (EPA—600/J-88/117). NTIS, PC A03/MF A01.

Pub. in Environmental Research, Vol. 46, 74-85(1988).

Male F344 rats were exposed by gavage to samples of complex mixtures and evaluated 24 hours later. Seven of the 10 samples caused death at doses ranging from 1 to 5 ml/kg body wt. Eight of the 10 samples were hepatotoxic based on histopathologic evaluation; 6 were centrilobular and 2 were periportal hepatotoxicants. The waste samples exerted toxicity through different mechanisms, as indicated by differences in the severity and lobular location of the tissue damage. With histopathological evaluation as the criterion, relative liver weight was the single best indicator of hepatotoxicity. Exposure to several of the waste samples increased serum total bilirubin and serum enzyme activities of alanine aminotransferase, aspartate aminotransferase, lactate dehydrogenase, alkaline phosphatase, and ornithine carbamyl transferase. As a battery, but not individually, the serum indicators separated the 8 hepatotoxic samples from the 2 nonhepatotoxic samples. In general, the hepatotoxicity of the waste samples did not appear to be readily predicted from (partial) chemical characterization data.

**9569 (PB—89-109581/XAB) Analysis of dose/time/response relationships for chronic toxic effects: the case of acrylamide.** Hattis, D.; Shapiro, K. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Technology, Policy and Industrial Development). Jul 1988. 72p. (CTPID—88-4). NTIS, PC A04/MF A01.

To conduct a risk assessment of hazards associated with the handling of acrylamide, a simple dynamic-analysis model was applied to the results of some classic studies of acrylamide neurotoxicity. The model incorporated the following assumptions: that a particular adverse effect occurs whenever a specific amount of damage is accumulated in the relevant portions of the nervous system, that damage is produced at a rate linear with the dose administered, and

that repair of the accumulated damage occurs at a rate directly dependent on the amount of accumulated damage to be repaired. Preliminary estimates were proposed of the risk posed to various proportions of the population by exposure to various air concentrations of acrylamide. For the most part the model focused on the reversible neurotoxic damage and its associated rates of repair. However, there was also evidence that some of the damage from acrylamide is not reversible. At ventilation rate of 10 cubic meters per 8 hour day, a 5-year exposure to acrylamide at 1.5 mg/cu m or a 40-year exposure to 0.18 mg/cu m would show an association to long term visual changes in average individuals.

9570 **(PB—89-109896/XAB) Pulmonary response to threshold levels of sulfur dioxide (1.0 ppm) and ozone (0.3 ppm) (journal version).** Folinsbee, L.J.; Bedi, J.F.; Horvath, S.M. (California Univ., Santa Barbara (USA). Environmental Stress Inst.). 1985. 7p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physiology, Vol. 58, No. 6, 1783-1787(1985).

The authors exposed 22 healthy adult non-smoking men for 2 hours to either filtered air, 1.0 ppm sulfur dioxide, 0.30 ppm ozone, or the combination of 1.0 ppm sulfur dioxide plus 0.30 ppm ozone. It was hypothesized that exposure to near-threshold concentrations of these pollutants would show any interaction between the two pollutants that might have been masked by the more-obvious response to the higher concentrations of ozone used in previous studies. Each subject alternated 30-minute treadmill exercise with 10-minute rest periods for the 2 hours. Following ozone exposure alone, forced expiratory measurements (FVC, FEV-1, and FEF25-75%) were significantly decreased. The combined exposure to $SO_2$ plus $O_3$ produced similar but smaller decreases in these measures. There were small but significant differences between the ozone and the ozone plus sulfur dioxide exposure for FVC, FEV-1,-2,-3, and FEF25-75% at the end of the 2-hour exposure. It was concluded that, with these pollutant concentrations, there is no additive or synergistic effect of the two pollutants on pulmonary function.

9571 **(PB—89-110308/XAB) Pulmonary function and symptom responses after 6.6-hour exposure to 0.12-ppm ozone with moderate exercise (journal version).** Folinsbee, L.J.; Horstman, D.H.; McDonnell, W.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1988. 10p. (EPA—600/J-88/052). NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 38, No. 1, 28-35(Jan 1988).

Episodes occasionally occur when ambient ozone ($O_3$) levels remain at or near 0.12 ppm for more than 6 h. The hypothesis that prolonged exposure to 0.12 ppm $O_3$ would result in progressively larger changes in respiratory function and symptoms over time was tested. Ten nonsmoking males (18-35 yr) were exposed once to clear air (CA) and once to 0.12 pp, $O_3$ for 6.75 h. Exposures consisted of six 50-min exercise periods, each followed by 10-min rest and measurement; a 45-min lunch period followed the third exercise period. Exercise ventilation averaged approximately 40 1/min. Forced expiratory and inspiratory spirometry and respiratory symptoms were measured prior to exposure and after each exercise. Increases in the symptom ratings of cough and pain on deep inspiration were observed with $O_3$ exposure but not with CA. Airway reactivity to methacholine was approximately doubled following $O_3$ exposure. Spirometry results indicate that prolonged exposure to 0.12 ppm $O_3$ results in a marked increase in non-specific airway reactivity and progressive changes in respiratory function.

9572 **(PB—89-110373/XAB) Electrostatic potentials of some dibenzo-p-dioxins in relation to their biological activities (journal version).** Murray, J.S.; Politzer, P. (New Orleans Univ., LA (USA). Dept. of Chemistry). 1987. 13p. NTIS, PC A03/MF A01.

Pub. in Theoretica Chimica Acta, Vol. 72, 507-517(1987).

A computational analysis of the electrostatic potentials of eight halogenated dibenzo-p-dioxins was carried out at the ab initio SCF STO-5G level. It focuses upon the relationships between these potentials and the biological activities of the molecules, including toxicity, aryl hydrocarbon hydroxylase induction and receptor binding. In general, regions of negative potential are found to be associated with the oxygens and with the halogen substituents. Biological activity appears to be related to the presence of an optimum range of negative potentials above the lateral portions of the molecules in conjunction with a weakening of those near the oxygens.

9573 **(PB—89-111777/XAB) Factors affecting possible carcinogenicity of inhaled nitropyrene aerosols. Research report, July 1984-July 1987.** Wolff, R.K.; Barr, E.B.; Bond, J.A.; Eidson, A.F.; Griffith, W.C. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). 1988. 47p. NTIS, PC A03/MF A01.

Tissue distribution of 1-nitropyrene was evaluated in rats after inhalation of pure compound or compound associated with gallium oxide particles. The influence of concomitant exposure to sulfur dioxide was also explored. There were no differences in tissue distribution if 1-nitropyrene was administered alone or in combination with gallium oxide particles, sulfur dioxide, or both. There was, however, a marked inflammatory and fibrogenic response to the gallium oxide. Alternatively, the effect of particle association on lung retention of 1-nitropyrene was investigated with the use of carbon black particles. The retention of $^{14}C$-1-nitropyrene adsorbed onto carbon black particles was higher than that of the compound inhaled as a pure aerosol. The amount of $^{14}C$ that was bound to particles steadily decreased with time after exposure, compared to total lung $^{14}C$, indicating removal of the $^{14}C$ from the particles.

9574 **(PB—89-123046/XAB) Health and environmental effects profile for methyl isocyanate.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Dec 1986. 65p. (EPA—600/X-87/053). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for methyl isocyanate was prepared to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act. Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous-waste constituents. Existing data are insufficient to determine a Reference Dose (RfD) or a carcinogenic potency factor for methyl isocyanate. Existing data are insufficient to determine an RQ value.

9575 **Synthesis and conformation of a dinucleoside monophosphate modified by aniline.** Jacobson, M.D.; Shapiro, R.; Underwood, G.R.; Broyde, S.; Verna, L.; Hingerty, B.E. (New York Univ., NY (USA)). *Chemical Research in Toxicology;* **1**: No. 3, 152-159(May-Jun 1988). Contract AC05-84OR21400.

The modified dinucleoside monophosphate, N-[deoxycytidyl-(3′-5′)-guanosin-8-yl]aniline (dCprG-An) has been prepared by the phosphotriester synthesis approach, using suitably blocked derivatives of dCp and N-guanosin-8-ylaniline (rG-An). The latter compound was synthesized by a route that featured nucleophilic displacement by aniline upon an 8-bromoguanosine derivative. A number of attempts to prepare N-(deoxyguanosin-8-yl)aniline (dG-An) by electrophilic substitution, using activated aniline derivatives, failed. Nucleophilic substitution reactions of aniline with 8-bromodeoxyguanosine derivatives afforded only the base, N-guanin-8-ylaniline. The conformation of dCprG-An has been studied by CD, proton magnetic resonance, and minimized potential energy calculations. A flexible molecule with a mixture of resonance, and minimized potential energy calculations. A flexible molecule with a mixture of conformers is indicated. Base-base stacked states predominate, in contrast to the case of a dimer containing 4-aminobiphenyl bound to the 8-position of guanine, where carcinogen-base stacked states are dominant. The mutagenic and carcinogenic activities of aniline are much less than those of many polycyclic aromatic amines. The diminished stacking ability of the aniline ring, as well as the weak electrophilic reactivity of activated aniline derivatives, may be a cause of this weak biological activity.

**9576 Illegitimate recombination induced by benzo[a]pyrene diol epoxide in Escherichia coli.** Kokontis, J.M.; Vaughan, J.; Harvey, R.G.; Weiss, S.B. (Franklin McLean Memorial Research Institute, Chicago, IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 4, 1043-1046(Feb 1988). Contract FG02-86ER60394.

Duplex DNA oligomer constructs (32 base pairs) were paired that contained a single benzo[a]pyrene (BP) adduct at a specific deoxyadenosine or deoxyguanosine site in either one or both strands. These constructs were inserted into M13 replicative form viral DNA, and the DNA from progeny virus generated by transfection of Escherichia coli was examined by sequence analysis at the site of oligomer insertion. With nonalkylated constructs, and with constructs containing only one BP adduct, no sequence alterations were found in progeny viral DNAs. With constructs containing two BP adducts, one in each strand and closely spaced, some progeny DNAs showed the original oligomer sequence, whereas others exhibited large deletions and illegitimate (non-homologous) recombination, both of which removed the damage construct. Increasing the distance between BP adducts in the construct reduced the frequency of recombinant events. These sequence alterations occurred in both $recA^+$ and $recA^-$ host cells. The authors speculate that the closely spaced adducts in opposite construct strands cause a rare distortion in DNA structure, which activates the recombinant machinery, and that mutagenic and carcinogenic agents other than polycyclic aromatic hydrocarbons may cause similar DNA distortions, which induce illegitimate recombination.

**9577 Ecology of an anaerobic dechlorinating consortium.** Tiedje, J.M.; Stevens, T.O. (Michigan State Univ., East Lansing (USA)). pp 3-14 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The mechanisms used by anaerobic bacterial communities to degrade organic molecules are of interest not only to increase the authors understanding of biogeochemical cycling, but also to explore the potential of microorganisms to degrade xenobiotic molecules in anaerobic environments. This has been of increasing concern in recent years, as many man-made chemicals are found to be toxic or mutagenic. New methods must be found to dispose of these compounds when they are no longer of use and to clean up contaminated areas. Digestion by anaerobic bacteria is an attractive possibility for disposal of synthetic chemicals, because it can require less energy than other methods of waste disposal; construction costs for anaerobic treatment facilities are lower; and anaerobic digestion offers the possibility of recovering useful products. Studying these processes also aids in predicting the fate of xenobiotics that have been introduced into natural anaerobic environments.

**9578 Performance of biodegradative microorganisms in soil: xenobiotic chemicals as unexploited metabolic niches.** Focht, D.D. (Univ. of California, Riverside (USA)). pp 15-29 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Microorganisms are where they are because there is a food source or a metabolic niche to exploit. The word niche has been synonymous in macroecology to location of habitat. In microbial ecology, niche refers to function rather than location. This is particularly significant with respect to bacteria, since the basic principle of nutritional selection has been used for isolating them from soil since the time of Beijerinck and Winogradsky a century ago. Reduced to basic simplicity, nutrition is the single most powerful selection force in microbial ecology in the absence of extreme environments. The microorganisms that are the best fitted for exploiting the metabolic niches of the environment are the ones that comprise the microbial community in accordance with Darwinian principles of natural selection. Thus, cellulitic fungi and proteolytic bacteria co-exist side by side spatially, while exploiting different niches, and can be isolated exclusively from each other on different selective media. The vast diversity of metabolic niches ranges in simplicity from ammonium to large, uncharacterized macromolecules.

**9579 Biotransformations of mercury compounds.** Summers. A.O. (Univ. of Georgia, Athens (USA)). pp 105-109 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The ability of bacteria to convert inorganic and organic mercury compounds to less toxic, volatile elemental mercury is among the most widely found plasmid-determined bacterial phenotypes. It is first the best understood and microbial metal transformation at levels of analysis from molecular genetics and biochemistry to population biology. Mercury compounds are important contaminants in some environmental sites. The compounds of the mercury detoxification system are: (a) the mercuric ion reductase, encoded by the mer A gene; (b) the mercuric ion transport system, encoded by the merTPC genes; (3) the organomercurial lyase, encoded by the merB gene (d) a polypeptide with no defined function, encoded by the merD gene; and the regulatory protein, encoded by the merR gene.

**9580 Bioremediation of chemical spills.** Brubaker, G.R.; Exner, J.H. (International Technology Corporation, Edison, NJ (USA)). pp 163-171 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

This chapter will discuss two case histories that involve microbial degradation of chemical contaminants. The first involves a combination of chemical and microbial methods used to clean up a sudden release of formaldehyde in a railroad yard. The second involves the use of in situ bioreclamation to clean up a more gradual leak of gasoline at a service station. In each instance, the in situ microbial approach avoided extensive excavation of soils, roadways, and/or railroads. Both instances also involved other remediation tools in addition to microbial remediation, emphasizing the need to examine complementary and synergistic remediation techniques wherever possible.

**9581 Remediation of multimedia contamination from the wood-preserving industry.** Pflug, A.D.; Burton, M.B. (BioTrol, Inc., Chaska, MN (USA)). pp 193-201 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Microbiology is useful in remediating sites contaminated with toxic and hazardous wastes. This chapter will focus on the wood-preserving industry, an industry that has a number of challenging environmental problems which it is currently addressing, not unlike the problems faced by many other industries in this country. The authors will examine briefly the historical practices of the wood-preserving industry, describe the problems that these practices have created, and address the role that microbiology can play in contaminant removal. Finally, they will describe the results that they are achieving or expect to achieve with the treatment systems that BioTrol is developing and using to permanently eliminate site contamination problems.

**9582 Preliminary development of a bench-scale treatment system for aerobic degradation of trichloroethylene.** Nelson, M.J.K.; Pritchard, P.H.; Bourquin, A.W. (Technology Applications, Inc., Gulf Breeze, FL (USA)). pp 203-209 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

This chapter summarizes the authors progress in understanding the aerobic biodegradation of TCE by strain G4 utilizing bench-scale batch cultures. Their results have demonstrated that TCE may be biodegraded to nontoxic products under certain conditions. Trichloroethylene is apparently degraded by strain G4 to $CO_2$, cellular carbon, and inorganic chloride. This activity requires aerobic conditions and exposure of the organism to certain aromatic compounds. This exposure is required to induce the biosynthesis of one of more enzymes that fortuitously degrade TCE. The normal function of the enzyme(s) is the metabolism of the aromatic compounds. Evidence from the work with environmental samples indicates that the natural microflora in a variety of areas is capable of TCE degradation is stimulated by the appropriate aromatic compounds.

9583 **Biological approaches for polychlorinated biphenyl degradation.** Unterman, R.; Bedard, D.L.; Brennan, M.J.; Bopp, L.H.; Mondello, F.J.; Brooks, R.E.; Mobley, D.P.; McDermott, J.B.; Schwartz, C.C.; Dietrich, D.K. (General Electric Company, Schenectady, NY (USA)). pp 253-269 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

Several years ago a research program was designed to isolate and characterize new and better strains of PCB-degrading bacteria and to characterize those biotransformations that are occurring in nature. Recently, this research program was expanded in an effort to explore the possibility of using one or more of the authors new bacterial isolates for the decontamination of PCB-laden soil. Corynebacterium sp. MB1, A. eutrophus H850, and P. putida LB400 had all been shown to have excellent PCB-degrading capabilities; however, little was known about their ability to oxidize PCBs adsorbed to soil. The authors initial studies using sand as a model demonstrated that PCBs were biodegradable even when bound to a solid substrate. They have continued with model biodegradation studies using PCB-laden soil containing either Aroclors or pure PCB congeners. They have extended their Aroclor biodegradation studies to higher concentrations and more difficult Aroclors. In addition to their Aroclor studies they have been conducting resting-cell assays using soil-bound pure PCB congeners in an effort to define the rates of degradation of selected PCB cogeners and to determine the metabolites produced from these biotransformations. Other research topics include: modeling nonbiological sources of apparent biodegradation; and biodegrading soil-bound polychlorinated biphenyls by genetically engineered bacteria.

9584 **Exploitation of the high affinity and specificity of proteins in waste stream treatment.** Furlong, C.E.; Sundstrom, J.A.; Weiler, E.B.; Cheung, P.W.; Yin, J.; Blanch, H.W. (Univ. of Washington, Seattle (USA)). pp 271-280 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

During the conference on Genetic Control of Environmental Pollutants held in Seattle in 1983, it became clear the adsorption systems with high affinities and specificities would be useful in removing specific pollutants from waste streams. Following the conference, the authors decided to explore the possibility of developing such systems, taking advantage of the high specificity and affinity offered by proteins. The present chapter addresses three areas of research: (a) the development of protein, peptide, and biomimetic adsorbers; (b) the development of microbiosensors and control systems for the continuous monitoring and automation of water treatment procedures; and (c) automation of the production of proteins used in ligand adsorbers and biosensors.

9585 **Some issues in biodegradation.** Alexander, M. (Cornell Univ., Ithaca, NY (USA)). pp 381-383 of Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Omenn, G.S. (ed.). New York, NY; Plenum Press (1988). (CONF-870794—).

From Reducing risks from environmental chemicals through biotechnology; Seattle, WA, USA (19 Jul 1987).

The author discusses some of the important issues in the area of biodegradation and in applying genetic engineering to biodegradation. Issues discussed include: enhancement of biodegradation; anaerobiosis; inoculation; toxins; acclimation; sorption; kinetics and risk.

## 5604 Other Environmental Pollutant Effects

*REFER ALSO TO CITATION(S) 8081, 8083, 8785, 9137, 9198, 9478*

9586 **(AD-A—197114/2/XAB) Operations and management of government-owned - contractor-operated microwave exposure facility. Volume 1. Effects of high-power pulsed microwaves on rats responding at high, moderate, and low response rates. Final report, 3 January 1985-2 January 1988.** Akyel, Y.; Hunt, E.; Bates, F.; Gambrill, C.; Vargas, C.A. (ERCI, Inc., Fairfax, VA (USA)). 28 Feb 1988. 26p. NTIS, PC A03/MF A01.

See also Volume 2, AD-A197 115.

In recent years, the relationship between high-peak-power microwave irradiation and biological systems has generated considerable interest. The relative effects of microwave fields are a function of the exposure fields power density, and specific absorption rate (SAR). Behavior is just as important a determinant of change as is the RF field itself, however, sufficient characterization and comparison requires an analysis that extends over a range of behavior. After training established stable baseline levels, rats were tested pre- and post-exposure for various microwave dose levels (including sham exposure). Analysis of cumulative response records and video-taped exposures failed to show any effects other than thermal for the various pulsed exposures when compared with equivalent average power exposures. This included the highest dose level (108W) which raised the rat's core temperatures up to 2.9 degrees C, and disrupted all activity. However, after approximately 10 minutes, an average decrease of 1.8 degrees allowed the animals to resume their schedules.

9587 **(AD-A—197115/9/XAB) Operations and management of government-owned - contractor-operated microwave exposure facility. Volume 2. Pulsed microwave effects on rat blood pressure and heart rate. Final report, 1 March 1985-2 January 1988.** Johnson, C.E.; Brown, D.; Bassen, H.; Bates, F. (ERCI, Inc., Fairfax, VA (USA)). 28 Feb 1988. 20p. NTIS, PC A03/MF A01.

See also Volume 3, AD-A197 116.

Using a specialized waveguide exposure system, the head and neck of 15 Sprague-Dawley rats were selectively exposed to 1250-MHz pulsed microwaves. Blood pressure, heart rate, and temperature were continually recorded. Statistical analysis of the physiological parameters that were recorded continuously revealed that during the exposure the animals exhibited no statistically significant change in core or head temperature, while heart rate decreased over 20%. The mean blood pressure remained constant but exhibited a sinusoidal undulation during exposure that was disassociated from heart rate. Cardiovascular parameters returned to normal soon after cessation of exposure. In summary, statistically significant changes were recorded concomitant with microwave exposure. Blood pressure exhibited a heretofore unreported oscillation, disassociated from heart rate. It is possible that this microwave reaction is mediated via baroreceptor cardiodepressor mechanisms.

9588 **(AD-A—197116/7/XAB) Operations and management of government-owned - contractor-operated microwave exposure facility. Volume 3. Physiological responses evoked in mice by high-power microwave pulses. Final report, 1 March 1985-1 February 1988.** Wachtel, H.; Bassen, H.; Brown, D.; Bates, F.; Gambrill, C. (ERCI, Inc., Fairfax, VA (USA)). 28 Feb 1988. 14p. NTIS, PC A03/MF A01.

See also Volume 1, AD-A197 114.

The investigator's primary objective was to determine whether bursts of narrow-pulse-width, high-intensity microwaves of low average power, would have different effects on the brain than would continuous-wave (CW) exposures yielding equivalent aver-

age SAR values. Two rather different approaches for ascertaining the neurophysiological response to patterned (pulsed) microwaves were followed. In one experiment, mice were exposed to single bursts of pulsed microwaves with sufficient energy to produce clear after effects, reduced activity, or hypokinesis. In the other experiment, each mouse was exposed sequentially to various microwave pulse bursts or CW radiation of substantially less energy, and the threshold for evoking motor response (body movements) is ascertained.

9589 **(AD-A—198243/8/XAB) Midwest free-electron laser program. Annual report, 1 March 1987-15 June 1988.** Cerullo, L.J.; Epstein, M.; Marhic, M.E.; Rymer, W.Z.; Spears, K.G. (Midwest Bio-Laser Inst., Chicago, IL (USA)). 31 Jul 1988. 15p. NTIS, PC A03/MF A01.

Subablative effects of pulsed Nd:YAG laser (1064 nm) radiation on the transmission of neural impulses in spinal cord dorsal white matter, spinal dorsal roots, and peripheral nerve in anesthetized rat were compared. The results to date indicate that long-lasting impairment in both spinal synaptic transmission and small fiber input may be mediated by laser irradiation. Nonlinear crystal mixing techniques have been employed to generate tunable infrared laser radiation in the 5-7 micron region with duration of 20 picoseconds. Characterization techniques of laser beams from the infrared to the ultraviolet were established for probing energy absorption and relaxation processes. Molecular studies of laser energy absorption and relaxation with relevance to fundamental studies in medicine and neuroscience were initiated. New methods to probe biological tissue with the FEL by spectroscopic or imaging techniques were developed. New fabrication techniques of the whispering-gallery waveguide have been employed to obtain high quality specimens. Needle-like hollow metallic IR waveguides were fabricated with lengths up to 30cm. A diffuse optics spectrophotometer was constructed that measures the optical constants of light-scattering layers from 450 to 1350 nm. Data analysis based on the diffusion approximation leads to values of the microscopic optical constants. The instrument has been employed in the measurements of endogeneous and exogeneous chromophore absorptions in tissue models in vitro plant and animal tissues.

9590 **(AD-A—198892/2/XAB) Noise and sonic-boom impact technology. BOOMAP2 computer program for sonic-boom research. Volume 1. Technical report. Final report, July 1986-November 1987.** Wilby, E.G.; Haber, J.M.; Bishop, D.E. (BBN Labs., Inc., Canoga Park, CA (USA)). Aug 1988. 89p. (BBN—6487). NTIS, PC A05/MF A01.

See also Volume 2, AD-A198 893.

The BOOMAP2 and MOAOPS computer programs analyze noise from supersonic aircraft-operations by extracting information from the ACMI/TACTS computer tapes. The MOAOPS program extracts information from a TACTS/ACMI mission standard data tape and compiles a computer library of information concerning the supersonic operations. The BOOMAP2 program utilizes the library produced by the MOAOPS program. The program calculates various statistics on the supersonic operations and calculates expected sonic boom levels on the ground based on the extracted information. BOOMAP2 can: (1) generate various spatial/temporal distribution statistics; (2) interface with sonic-boom generation and propagation models; (3) calculate the intensity and location of sonic booms reaching the ground; and (4) provide the data file used by a commercial graphical software package, GRCP, to plot contours of boom exposure in units of average peak overpressure or C-weighted day-night average sound level (CDNL). These two programs, when used with an adequate library of aircraft sorties from Military Operating Areas, can be an invaluable tool for environmental planning purposes to predict boom intensity, frequency, and distribution. This report describes the technical basis for the BOOMAP2 program developed under this contract.

9591 **(AD-A—198893/0/XAB) Noise and sonic-boom impact technology. BOOMAP2 computer program for sonic-boom research. Volume 2. Program users/computer operations manual. Final report, July 86-November 1987.** Day, P.J.; Reilly, T.M.; Seidman, H. (BBN Labs., Inc., Canoga Park, CA (USA)). Aug 1988. 53p. (BBN—6488). NTIS, PC A04/MF A01.

See also Volume 1, AD-A198 892.

The BOOMAP2 and MOAOPS computer programs analyze noise from supersonic aircraft operations by extracting information from a TACTS/ACMI mission standard data tape and compiles a computer library of information concerning the supersonic operations. The BOOMAP2 program utilizes the library produced by the MOAOPS program. The program calculates various statistics on the supersonic operations, and calculates expected sonic boom levels on the ground based on the extracted information. BOOMAP2 can: 1) generate various spatial/temporal distribution statistics; 2) interface with sonic boom generation and propagation models; 3) calculate the intensity and location of sonic booms reaching the ground; and 4) provide the data file used by a commercial graphical software package, GPCP, to plot contours of boom exposure in units of average peak overpressure or C-weighted day-night average sound level (CDNL). These two programs, when used with an adequate library of aircraft sorties from Military Operating Areas, can be an invaluable tool for environmental planning purposes to predict boom intensity, frequency, and distribution. This report provides the program user's manual and computer operation's manual for the BOOMAP2 program developed under this contract.

9592 **(AD-A—199489/6/XAB) High-peak-power microwave pulses at 1.3. GHz: effects on fixed-interval and reaction-time performance in rats. Interim report for period ending 1987.** D'Andrea, J.A.; Cobb, B.L. (Naval Aerospace Medical Research Lab., Pensacola, FL (USA)). Dec 1987. 19p. (NAMRL—1337). NTIS, PC A03/MF A01.

The current safety standards for radiofrequency and microwave exposure do not limit the peak power of microwave pulses for general or occupational exposures. To determine whether high peak-power microwave pulses can alter known thresholds of behavioral disruption, four Long-Evans male rats were exposed to peak powers of 496.7, 336.7, and 146.7 kW in a waveguide exposure system while performing a time-related behavioral task. The task consisted of two components: a fixed interval schedule of reinforcement on one response lever and reaction time on a second lever. Responding on each lever was dependent on visual signals displayed through the translucent plastic levers. Trained rats performed the behavioral task during exposure to 1.3-GHz microwave pulses at a pulse repetition rate of 10 Hz. Significant changes occurred in behavioral performance. Session time increased, response rates decreased, and reaction times significantly increased at whole-body SARs of 6.3 and 10.5 W/kg. The alteration of behavior in this study occurred at a whole body SAR between 3.5 and 6.3 W/kg, which is consistent with previous estimates of 4 W/kg as the threshold for behavioral alteration. The high peak power pulses used in this study did not alter this threshold, suggesting that the primary effect must be tissue heating.

9593 (CONF-8611277—, pp 169-182) **Investigation of motorcycle noise sources by acoustic holography method.** Sawai, Seiji; Takahashi, Kazuki; Isobe, Kensaku. (Yamaha Motor Co. Ltd., Shingai (Japan)). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

As the recent noise source investigation method, the acoustic intensity method adopting two-microphone technique has been used generally. In this paper, for a method to obtain the location and intensity of noise sources by performing the acoustic holography method, measurement devices and data processing system are introduced. And an example of actually applying the measurement of noise emitted by a motorcycle is also reported. (orig).

9594 (CONF-8611277—, pp 191-206) **Results of primary noise reduction measures on single cylinder two-stroke petrol engines.** Kuentscher, V.; Engler, G. (Ingenieurhochschule Zwickau (German Democratic Republic). Sektion Kraftfahrzeugtechnik). 1986. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE89770175/JAW.

From 2. Graz motorcycle conference: Exhaust - noise - new engine concepts; Graz, Austria (17 Nov 1986).

Mitteilungen des Institutes fuer Verbrennungskraftmaschinen und Thermodynamik, Technische Universitaet Graz.; no. 48.

EEC Regulations No 41/1/2 for two-wheeled vehicles and No 63/3 for mopeds, came into force in recent years as necessary contributions for improved environmental protection and for greater safety in traffic. The achievement of the long-term limits intended for the future will require considerable efforts from the motorcycle industry. As a contribution to this, extensive investigations were done on standard singlecylinder two-stroke petrol engines with a swept volume of 50 cc and of the same type, for which several variants were produced in order to meet the aim of less noise emission. This is a report on the results achieved.

9595 **(CRIE-U—87021) Biological effects of HVDC transmission line environments on animals. Design of a prototype animal exposure system.** Shigemitsu Tsukasa; Shiga, Yoichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755714/JAW.

HVDC transmission entails little transmission loss and is used to transmit power from Honshu to Hokkaido. The issue to be studied is the influence of HVDC lines on creatures. The Electrical Power Research Center has designed and manufactured the prototype of a testing device with which to expose mice to a combined environment of ions and a DC field. The research team equipped a cup-shaped 60 cm-diameter, 50 cm-deep metal cage with condition-adjustable electrodes to enable ions and electric fields to be distributed equally. Field and ion fluctuations were within 20% in the middle of the bottom of the cage in the activity range of mice. The maximum ion density and field strength were $10^6$ pcs/cc and 30 kV/m respectively, greater than the maximum allowable values. The ventilation status of the testing device was secured by removing airborne particles, inhibiting airflow velocity, and reducing ozone generation (within 0.05 ppm at 1 cm/s). The device was also equipped with an automatic detector for spontaneous movement, eating, and drinking. (13 figs, 6 tabs, 1 photo, 25 refs)

9596 **(CRIE-U—87034) Behavioral monitoring of mouse during short term. Exposure to air ions and DC electric fields.** Shigemitsu, Tsukasa; Shiga, Yoichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755715/JAW.

DC current is characterized by a small loss and is used in the Honshu-Hokkaido power transmission line in Japan. The research team made a monitoring device to check changes in mouse activity during the short-term exposure of mice to air ions and DC electric fields. Six male mice, one at a time, were used in each of the following conditions: (1) positive exposure to positive ions and positive fields, (2) negative exposure to negative ions and negative fields, and (3) absence of electric stimulation. Immediately being exposed to an ion density of $10^6$ pcs/cc and an field strength of 15 kV/m (positive and negative), mice proved more active. However, this state was temporary. After one hour, these mice returned to the same level as those not exposed to electrical stimulation, even during exposure. The difference in analysis of variance of portions corresponding to the exposure time was 0.02% between mice with negative exposure and those not exposed to electrical stimulation, and was 3% between mice with positive exposure and those not exposed. The latter case showed a significant difference in the amount of activity (at intervals of 20 min). These findings qualitatively corresponded to the results of exposure tests using ions alone. (8 figs, 13 tabs, 10 refs)

9597 **(PB—89-105936/XAB) Immunologic effects of nonionizing electromagnetic radiation (journal version).** Smialowicz, R.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 7p. (EPA—600/J-87/417). NTIS, PC A02/MF A01.

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Engineering in Medicine and Biology Magazine, 47-51(Mar 1987).

Many of the studies in which animals or cells have been exposed at various frequencies and intensities of NER radiation have reported inconsistent and transient changes in the functional integrity of the immune defense system. Many of the reported immune effects of NER, however, appear to result from a generalized stress response which is due to NER-induced heating. The absence of increases in core temperature following NER does not preclude a thermal interaction that the animal is able to compensate for and control. Conclusions of the human health implication of observed interactions of NER with the immune system in experimental models must be made most cautiously. There is presently no convincing evidence from in vitro or in vivo studies for adverse alterations in the immune system at NER radiation intensities comparable to average environmental levels, i.e., 0.01 to 0.1 microwatts/$cm^2$ in the frequency range of 54 to 900 MHz, which encompasses the resonant frequency for humans.

9598 **(PB—89-105977/XAB) Effects of microwave exposure and temperature on survival of mice infected with Streptococcus pneumoniae (journal version).** Liddle, C.G.; Putnam, J.P.; Lewter, O.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 10p. (EPA—600/J-87/424). NTIS, PC A02/MF A01.

Pub. in Bioelectromagnetics, Vol. 8, 295-302(1987).

Female CD-1 mice were injected with an LD50 dose of Streptococcus pneumoniae and then exposed to 2.45 GHz (CW) microwave radiation at an incident power density of 10 mW/cm2 (SAR approximately equals 6.8 W/kg), 4 h/d for 5 d at ambient temperatures of 19, 22, 25, 28, 31, 34, 37 and 40°C. The results showed that survival of sham exposed animals increased as ambient temperature increased until 37°C when the thermoregulatory capacity of the animals was exceeded and deaths due to hyperthermia occurred. Survival of microwave exposed animals was significantly greater than the shams (approximately 20%) at each ambient temperature below 34°C. An analysis of the data suggests that the hyperthermia from microwaves may be more effective in increasing survival than conventional hyperthermia. The results indicate that microwave radiation may be beneficial to infected animals at low and moderate ambient temperatures, but detrimental when combined with high ambient temperatures.

9599 **(PB—89-106033/XAB) Radiofrequency radiation: activities and issues, a 1986 perspective (journal version).** Elder, J.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 7p. (EPA—600/J-87/420). NTIS, PC A02/MF A01.

Pub. in Health Physics, Vol. 53, 607-611(1987). See also PB—86-217155.

The following topics are discussed in the report: (1) environmental exposure levels of radiofrequency (RF) radiation; (2) Federal and other activities related to the control of exposure to RF radiation; (3) biological effects; (4) limitations in the knowledge of biological effects; and (5) research budgets.

9600 **(PB—89-109706/XAB) Effect of ambient levels of power-line-frequency electric fields on a developing vertebrate (journal version).** Blackman, C.F.; House, D.E.; Benane, S.G.; Joines, W.T.; Spiegel, R.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1988. 14p. (EPA—600/J-88/091). NTIS, PC A03/MF A01.

Pub. in Bioelectromagnetics, Vol. 9, 129-140(1988).

Fertilized eggs of Gallus domesticus were exposed continuously during their 21-day incubation period to either 50 or 60-Hz sinusoidal electric fields at an average intensity of 10 Vrms/m. Within 1.5 days after hatching, the chickens were removed from the apparatus and tested. The test consisted of examining the effect of 50- or 60-Hz electromagnetic fields at 15.9 Vrms/m and 73 nTrms (in a local geomagnetic field of 38 uT, 85 deg N) on efflux of calcium ions from the chicken brain. For eggs exposed to 60-Hz electric fields during incubation, the chicken brains demonstrated a significant response to 50-Hz fields but not to 60-Hz fields, in agreement with the results from commercially incubated eggs. In contrast, the brains from chicks exposed during incubation to 50-Hz fields were not affected by either 50- or 60-Hz fields. These results

demonstrate that exposure of a developing organism to ambient power-line-frequency electric fields at levels typically found inside buildings can alter the response of brain tissue to radiation-induced calcium-ion efflux.

**9601 (PB—89-110167/XAB) EPA (Environmental Protection Agency) must continue to monitor research in the field of non-ionizing radiation research and provide technical support and assistance to other government agencies. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 19 Jul 1988. 7p. (SAB/RAC—88/031). NTIS, PC A02/MF A01.

The EPA Science Advisory Board's (SAB) Radiation Advisory Committee believes EPA must continue to monitor research in the field of non-ionizing radiation research and provide technical support and assistance to other government agencies. In its January 31, 1984 report, the SAB recommended periodic review and evaluation of new research, a strengthening of in-house and extramural research, and a continuation of the Agency's monitoring of ambient levels and its technical support to other government agencies to assure compliance with its guidance. Apart from one periodic review, EPA has carried out none of these recommendations and is unlikely to implement them now despite renewed nationwide interest in the effects of non-ionizing radiation as a possible cancer promoter and the imminent issuance of a Guidance that is to be implemented by other Federal agencies.

**9602 (PB—89-850994/XAB) Acoustic intensity measurement. January 1975-November 1987 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-November 1987.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 160p. NTIS PC N01/MF N01.

This bibliography contains citations concerning techniques and devices for the measurement of acoustic intensity from a variety of sources. Topics include automated measuring systems, calibration, transient-noise sources, errors in acoustic-intensity measurements, source characterization, and finite-difference approximation errors. (This updated bibliography contains 383 citations, none of which are new entries to the previous edition.)

**9603 (PB—89-851000/XAB) Acoustic intensity measurement. December 1987-November 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Ccommunities data base). Report for December 1987-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 37p. NTIS PC N01/MF N01.

Supersedes PB—88-853171.

This bibliography contains citations concerning techniques and devices for the measurement of acoustic intensity from a variety of sources. Topics include automated measuring systems, calibration, transient-noise sources, errors in acoustic intensity measurements, source characterization, and finite-difference approximation errors. (This updated bibliography contains 55 citations, all of which are new entries to the previous edition.)

**9604 (PB—89-851208/XAB) Industrial-noise control: architectural and environmental aspects. January 1975-November 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Nov 1988. 127p. NTIS PC N01/MF N01.

Supersedes PB—86-864337.

This bibliography contains citations concerning architectural and engineering acoustics associated with noise control in industrial environments. Important sources of industrial noise and the level of exposure by workers to noise are examined. Methods for active attenuation of noise, that is, the cancelling of a noise by the addition of further noise is examined. Both absorptive and non-absorptive noise control methods are presented. (This updated bibliography contains 251 citations, 43 of which are new entries to the previous edition.)

**9605 (PB—89-851612/XAB) Noise-induced hearing loss. January 1972-November 1988 (Citations from the International Aerospace Abstracts data base). Report for January 1970-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 166p. NTIS PC N01/MF N01.

Supersedes PB—85-860591; U.S. sales only.

This bibliography contains citations concerning environment-related acoustic trauma. Primary consideration is given to flight personnel, both military and non-military. The sources of noise stress and related factors as sound level, sound frequency, and exposure time are considered. The pathology, diagnosis, therapy, and prevention are discussed. (This updated bibliography contains 371 citations, 166 of which are new entries to the previous edition.)

**9606 (PB—89-851620/XAB) Noise control and abatement: transportation systems and heavy industry. October 1981-November 1988 (Citations from Information Services in Mechanical Engineering data base). Report for October 1981-November 1988.** (National Technical Information Service, Springfield, VA (USA)). Dec 1988. 64p. NTIS PC N01/MF N01.

Supersedes PB—84-855303.

This bibliography contains citations concerning noise generation, control, and abatement in the transportation industry and heavy industrial environments. The applications of environmental engineering to human factors, such as fatigue due to industrial noise exposure and the relationship of physical fatigue and worker safety are presented. (This updated bibliography contains 133 citations, 64 of which are new entries to the previous edition.)

# 57 HEALTH AND SAFETY

*REFER ALSO TO CITATION(S) 9479*

**9607 (AD-A—198580/3/XAB) Light-fighter communication - on today's chemical battlefield. Master's thesis, August 1987-June 1988.** Hale, T.J. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA)). 3 Jun 1988. 198p. NTIS, PC A09/MF A01.

The format of the thesis is as follows: Chapter 1 is an introduction; Chapter 2 surveys the history of chemical warfare and the evolution of the Chemical Warfare Service (CWS); Chapter 3 reviews the Soviet offensive use of chemicals; Chapter 4 presents a fictional scenario to illustrate the communications problems of the light fighter under combat conditions in a tropical climate; and Chapter 5 assimilates key-scenario communication events with applicable governmental and field studies conducted since 1969. The thesis scenario logically discusses and portrays today's chemical equipment and NBC communication training. The scenario's intent is to challenge a leader to analyze how a unit could be properly trained and maneuvered in today's low-intensity chemical battlefield.

**9608 (CONF-8810249—1) Diffusion of emergency warning: Comparing empirical and simulation results.** Rogers, G.O.; Sorensen, J.H. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004171/JAW.

From Annual meeting of the Society for Risk Analysis; Washington, DC, USA (31 Oct 1988).

As officials consider emergency warning systems to alert the public to potential danger in areas surrounding hazardous facilities, the issue of warning system effectiveness is of critical importance. The purpose of this paper is to present the results of an analysis on the timing of warning system information dissemination including the alert of the public and delivery of a warning message. A general model of the diffusion of emergency warning is specified as a logistic function. Alternative warning systems are characterized in terms of the parameters of the model, which generally constrain the diffusion process to account for judged maximum penetration of each system for various locations and likelihood of being in those places by time of day. The results indicate that the combination of either telephone ring-down warning systems or tone-alert radio sys-

tems combined with sirens provide the most effective warning system under conditions of either very rapid onset, or close proximity or both. These results indicate that single technology systems provide adequate warning effectiveness when available warning time (to the public after detection and the decision to warn) extends to as much as an hour. Moreover, telephone ring-down systems provide similar coverage at approximately 30 minutes of available public warning time. 36 refs., 5 figs., 3 tabs.

9609 (INIS-XN—136) **Act No. 87-565 of 22 July 1987 on the organization of public safety measures, forestry protection against fires and the prevention of major risks.** (International Atomic Energy Agency, Vienna (Austria)). 23 Jul 1987. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704927/JAW.

Published in Journal Officiel de la Republique Francaise.

As defined by this Act, the objective of the public safety measures is to prevent all types of major risks and to protect persons, property and the environment, including forests, against accidents, disasters and catastrophes. It deals with the conditions for preparing preventive measures and for implementing necessary measures in case of major risks or accidents. The preparation and organization of assistance are determined within the framework of ORSEC (ORganisation des SECours) plans and emergency plans; the first assess the possibilities for facing up to disasters while the latter provide for measures and means to overcome a particular risk.

# 58 GEOSCIENCES

## 5801 Geology And Hydrology

*REFER ALSO TO CITATION(S) 7569, 7570, 7571*

9610 (DOE/ER/60246—T1) **Hydrological and geochemical response and recovery in disturbed arctic ecosystems.** Everett, K.R. (Ohio State Univ. Research Foundation, Columbus (USA)). 1988. Contract FG02-84ER60246. 52p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004678/JAW.

The investigations proposed in the following pages fall into three general categories. First, maintenance in Phase II of hydrogeochemical and hydrological data base begun in the Imnavait Creek watershed in 1985. These data were collected to answer questions concerning the ionic composition of precipitation considered to be the principal, if not the only, source of input. The second category of investigations proposed as part of the conceptual framework put forth for Phase II of the R4D program constitute new directions of research that build on those of Phase I. For example, it has become clear that the watershed of Imnavait Creek and those of its water track sub-basin do not contribute uniformly to either the discharge of the stream or to its ionic water flow across the different slope elements. Thus it is necessary to experimentally study subsurface solute movement and develop transport models that incorporate the physical and chemical characteristics of the soils. This includes the spatial or map distribution of soil types and accompanying vegetation to completely portray soil-soil solution vegetation interactions on the continuum of slope elements. It also appears that major ionic inbalances in surface water budgets are tied to the dissolved organic component both of the soil water and surface water. 19 refs., 13 figs.

9611 (DOE/SR/15160—2) **Hydrogeologic investigation and establishment of a permanent multi-observational well network in Aiken, Allendale and Barnwell Counties, South Carolina, Phase 2: Technical progress report, year 2, August 1987--August 1988.** Kuntz, G.B.; Griffin, W.T. (South Carolina Water Resources Commission, Columbia (USA). Geology-Hydrology Div.). Oct 1988. Contract FC09-86SR15160. 138p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004371/JAW.

The South Carolina Water Resources Commission (SCWRC), in its continuing efforts to acquire water-resource information for all parts of the state, and being aware of the deficiency of detailed geologic and hydrologic data for the area surrounding the Savannah River Plant (SRP), began a geohydrologic investigation in part of the Lower Savannah River Project Area in 1986. The area, consisting of Aiken, Allendale, and Barnwell Counties in western South Carolina, lies almost entirely within the Coastal Plain physiographic province. The framework for the investigation is centered on a well cluster system, an extension of the well cluster system being constructed on the plant site as a part of the "SRP Baseline Hydrogeologic Investigation." The format of the information obtained is compatible with that of the SRP project. The entire well cluster project, as originally proposed, consists of ten well cluster sites, of five to ten wells each, located peripheral to SRP. The well cluster sites C-2 and C-6 were selected as part of Phase 1 activities. Phase 2 well cluster sites (C-3 and C-5) were selected on the basis of the preliminary data obtained during Phase 1. The locations of the remaining sites are tentative and will be based on the data obtained during Phases 1 and 2. 3 refs., 16 figs., 1 tab.

9612 (GSJ—8703, pp 93-119) **Greated era of volcanic front in Middle Kyushu and Western Chugoku districts.** Kamata, Hirotake; Hoshizumi, Hideo; Koyaguchi, Takehiro. (Geological Survey of Japan, Tsukuba, Japan; Ehime Univ., Faculty of Science, Matsuyama, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

Purpose of this study was to determine the era when the creation of the volcanos commenced which were extending from north-east to south west, by using the K-Ar age of volcanic rocks which were continuously distributed from middle Kyushu to San-in district and which were mainly composed of amphibole andesite. By comparing with geological map, relation with the stratigraphic order of layers at Yabakei, Himejima and Aono were considered. It was concluded that, in every place, the vocanic activities commenced much later era than creation of basement rock. It was also recognized that, by studying the relation with Phillipine Plate, deep earthquake was related with the volcanic front of south west Japan arc. (8 figs, 2 tabs, 14 refs)

9613 (GSJ—8703, pp 109-119) **K-Ar age and chemical composition of basalt, andesite distributed in Shimabara peninsula.** Nakata, Setsuya; Kamata, Hirotake. (Kyushu Univ., the Faculty of Science, Fukuoka, Japan). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

Regarding the volcanic rocks genarated by eruption of volcanos in Shimabara Penisula, historical process of change of chemical compositions were studied. For determining the chemical compositions of basalt, andesite, X-ray fluorescence analysis was applied. By this result, distribution map of potassium and other microelements contained in the basalt and andesite was completed. It was considered that magma of similar composition were continuously kept supplied to north-western Kyushu including Shimabara Penisula since later Mesozoic era, that island arc type magma was generated at least 1.4 million years ago by the action of ocean plate, and that andesites were produced by mixing magma of hot spot type with that of island arc type. (3 figs, 2 tabs, 31 refs)

9614 (LA—11453-OBES) **Field Procedures Manual: Shady Rest, California, and Sulphur Springs, New Mexico.** Goff, S. (Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 14p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004538/JAW.

This Field Procedures Manual is the comprehensive operations guide to be used to curate samples obtained from the Shady Rest site at Mammoth, California, and the Sulphur Springs site at Valles caldera, New Mexico (VC-2A). These sites are diamond drilling projects in small-diameter holes that will produce continuous core. Fluid samples will also be of primary importance at both of these sites. Detailed core and fluid handling procedures are therefore the major focus of this manual. The manual provides a comprehensive operations guide for the well-site geoscientists

working at the Department of Energy/Office of Basic Energy Science (DOE/OBES) Continental Scientific Drilling Program (CSDP)/Thermal Regimes drill sites. These procedures modify and improve those in previous DOE/OBES field manuals. 1 ref., 7 figs.

## 5802 Geophysics

*REFER ALSO TO CITATION(S) 7292, 7364, 7656, 7663, 7665, 7666, 7667, 7669, 9128, 9129, 9130, 9140*

**9615 (PB—88-248208/XAB) Seismology, 1987 nuclear test-ban verification, earthquake, and earth resource investigation.** Eriksson, A.; Ivansson, S. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). 1988. 31p. (FOA-C—20710-9.1(2.2)). NTIS, PC E03/MF A01.

Summary in Swedish. See also PB—88-108709; Color illustrations reproduced in black and white.

This work described concerns detection seismology, local seismicity, and seismic exploration. The chapter on detection seismology can be divided into five parts. First, the current work within the Group of Scientific Experts in Geneva is described. Then a compilation is presented of the known nuclear tests performed in 1987. Third, the plans for the upgrade of the Hagfors array station are described along with some research carried out in this context. The fourth part consists of a few research notes pertaining to discrimination, depth estimation, and yield estimation. The high-frequency part of the S divided by P ratio is shown to be a good discriminant at regional distances. Finally, the authors' division has been affected by the work within the Six-Nation Initiative. As for the studies on local seismicity, one should note that a new local network in northern Sweden, comprising six stations, has now been taken into operation. The authors work on seismic exploration has involved two field experiments and a modelling study.

**9616 (SAND—88-2410) Seismic array performance analysis using a hybrid expert system.** Walck, M.C.; Elbring, G.J.; Hiebert-Dodd, K.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004665/JAW.

Several factors contribute to the performance of a seismic array in locating events; configuration, frequency response, and distribution of sensor types are all important. Statistical analysis of the effect of these multiple variables on event location accuracy requires tedious repeated runs of analysis codes, using different input data sets and parameters. A hybrid expert system is an ideal tool to aid in processing and analyzing massive amounts of data and creating and manipulating a data base. This relatively new concept is a coupling of artificial intelligence (AI) programming techniques with analysis codes. Our expert system combines the individual strengths of an AI machine (Symbolics 3610) and conventional microcomputer (Micro VAX II). Code written in Lisp on the Symbolics provides the user interface, maintains the data base and runs the desired FORTRAN codes, which reside on the Micro VAX II. Functions are provided for entering data into the data base, analyzing data sets with respect to multiple variables, and inspecting the results in graphical form. The system is easily expandable to include new analysis methods. We demonstrate the capabilities of the hybrid expert system, ASSISTANT, using teleseismic data from the NORESS and ARCESS seismic arrays. The effects of array configuration, event set, frequency band, and location algorithm on the event location accuracy are illustrated using several examples. 11 refs., 18 figs.

**9617 (UCID—21596) Seismic hazard characterization of the Savannah River Plant site (SRP).** Savy, J. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 117p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89004984/JAW.

The scope of this study is to perform for the Savannah River site the same kind of calculation as performed for the Nuclear Regulatory Commission (NRC), using the same methods and data, as those used for all the active Nuclear Power Plant (NPP) sites located east of the Rocky Mountains. The study was specifically designed to provide a set of tools with which the hazard at all the plant sites in the Eastern United States (EUS) could be estimated. However it must be noted that the very specific characteristics of each plant site are only accounted for in a generic fashion. For example, the local site corrections used eight different site categories rather than any site specific factors. In addition, the models of seismicity developed did not concentrate on any specific site locations, but were provided for the entire EUS. Similarly, the ground motion models used in the analysis did not concentrate on small regions, rather, they were separated in four different groups of models applicable to the four areas in the EUS, namely the Northeast, the Southeast, North central, and South central EUS. The results provided by the NRC/LLNL methods with the present data banks are accurate enough that they can be used in screening techniques and for preliminary types of analyses. If a detailed site specific analysis were deemed necessary at a site, a careful revisiting and possibly updating of each of the links in the chain of analyses leading to the final data base would be appropriate. 2 refs., 105 figs., 1 tab.

**9618 (EPRI-NP—4726-A-Vol.1-Pt.1) Seismic hazard methodology for the central and Eastern United States: Volume 1, Part 1: Theory: Final report.** McCann, M.W. Jr. (ed.); McGuire, R.K.; Veneziano, D.; Dyck, J.V.; Toro, G.; Kulkarni, R.; Cornell, C.A. (Electric Power Research Inst., Palo Alto, CA (USA); Benjamin (J.R.) and Associates, Inc., Mountain View, CA (USA); Risk Engineering, Inc., Golden, CO (USA); Woodward-Clyde Consultants, San Francisco, CA (USA); Cornell (C.A.), Portola Valley, CA (USA)). Nov 1988. 242p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004135/JAW.

The NRC staff concludes that SOG/EPRI Seismic Hazard Methodology, as documented in the topical report and associated submittals, is an acceptable methodology for use in calculating seismic hazard in the Central and Eastern United States (CEUS). These calculations will be based upon the data and information documented in the material that was submitted as the SOG/EPRI topical report and ancillary submittals. However, as part of the review process the staff conditions its approval by noting areas in which problems may arise unless precautions detailed in the report are observed. 48 refs., 20 figs., 7 tabs.

**9619 Correlation of Avalonian regions and their role in Paleozoic orogenies.** Dreier, R.B. (Oak Ridge National Laboratory, TN (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 566(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Avalonian regions are characterized by rock types usually found in tectonically active settings. Differences between Avalonian regions suggest that they do not share a specific common history: 1) regions show little similarity in basement age and characteristics: 2) separate regions began forming at different times: 3) not all regions show evidence of Cadomian I orogenesis: 4) timing and style of Avalonian-Cadomian II orogenesis varies between regions; and 5) Cambrian sections differ in lithologic character. Development of Avalonian regions maybe similar to modern circum-pacific activity, where similar age rocks, associated with active tectonism, are being formed around the perimeter of the Pacific Ocean. Evolution of Avalonian regions could, at least in part, be related to Pan African tectonism and regions may constitute part or parts of a mobile belt at the margin of the African craton. Avalonian regions may be divided into three regions that acted independently of each other during the Paleozoic. The first region (Carolina Slate Belt and the Nashoba Zone of Southeaster New England) may have accreted to North America during the Ordovician. The second region (Nova Scotia, Newfoundland, Avalonian regions in the United Kingdom, and Britany) rifted from Gondwana after the Ordovician and collided with Laurasia during the Devonian-Acadian orogeny. The third region (Boston Platform and New Brunswick) remained attached to Gondwana throughout the Paleozoic, and collided with Laurasia during the Permian Alleghanian orogeny.

## 5803 Mineralogy, Petrology, And Rock Mechanics

*REFER ALSO TO CITATION(S) 7493*

**9620 (DOE/ER/10445—5) Experimental study of opening-mode crack growth in rock: Final report, July 1, 1984--June 30, 1988.** Gordon, R.B. (Yale Univ., New Haven, CT (USA). Dept. of Geology and Geophysics). Aug 1988. Contract AC02-79ER10445. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003821/JAW.

A test method suitable for measuring the fracture energy of large rock samples was developed. Fracture energies were measured on rock having a wide range of microstructures. The effect of microstructural differences on the fracture energies was found to be large and the effects of crack speed and chemical environment, small. Structural features controlling the fracture energy were identified. Microscopic observation of growing cracks was used to find the processes by which a rupture surface forms in rock. The size of the zone of energy dissipation during fracture and the amount of structural damage to the rock caused by crack propagation were determined. 4 refs.

**9621 (GSJ—8703, pp 155-165) Rock density in south Aize area.** Takakura, Shin'ichi; Yamaguchi, Yasushi. (Geological Survey of Japan, Tsukuba, Japan). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755742/JAW.

In Study of evaluation technique of geothermal resources. Sunshine Project in 1986, Intermediate report on performance of research and development.

This report is II-9 of an interim report on research and development of the Sunshine Project for 1986. A few caldera exist in the South Aizu area with accompanying Bouguer abnormality. However, because of very steep geographical position, the Bouguer abnormality diagram considerably changes and makes an evaluation of scales of the caldera very difficult. detailed study of the gravity structure was made by measuring the density over wide areas. Measurement of the rocks collected in July, 1986 and the fundamental design on the data base of the rock density were conducted. The rock density measurement showed the surface density of the surface layer, and the difference in the average density between the basic rocks and the rocks of the Tertiary and the Quarternary Periods. Further detailed collection of data per area or geological sections and setting the correspondence with the rock ages is a future problem. (3 figs, 4 tabs, 1 ref)

**9622 Extent of water-rock interactions in Lower Permian Wolfcamp carbonates, Palo Duro Basin, Texas.** Fisher, R.S.; Posey, H.H. (Univ. of Texas, Austin (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 583(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

A laterally-extensive permeable zone in upper Wolfcampian carbonate strata constitutes the first important transmissive unit below a thick evaporite sequence that is being considered for nuclear waste isolation. The extent of water-rock interaction was evaluated by comparing the chemical and isotopic composition of formation water and core collected at four DOE test wells. Wolfcamp mineralogy is dominantly calcite and dolomite with minor anhydrite at each of the four sites despite minor variations in depositional environment, diagenetic alteration, and abundance of clastic material. Isotopic compositions of calcite and dolomite and of anhydrite are within the ranges expected for Permian marine sediments altered by early diagenesis. Wolfcamp formation water compositions are more variable than host rock compositions, and are not completely controlled by local water-rock equilibria. Wolfcamp brines from two wells in the western part of the basin have depleted isotopic compositions relative to the two eastern wells and have not equilibrated with Wolfcamp carbonates, whereas the eastern fluids have. Strontium in the western samples is more radiogenic than that of the eastern samples, indicating a greater influence of clays or feldspars on the western fluids. Comparison of water and rock compositions suggests: (1) the western brines have interacted less with the carbonate host than the eastern brines due to shorter residence times or greater water: rock ratios, and (2) the minerals encountered along flow paths prior to entering the Wolfcamp are different for the western and eastern Wolfcamp brines.

## 5804 Geochemistry

*REFER ALSO TO CITATION(S) 7240, 9359, 9622*

**9623 Preliminary evaluation of oxygen isotopic exchange between chlorite and water.** Cole, D.R. (Oak Ridge National Laboratory, TN (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 550(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Variations in the oxygen isotopic composition of biotites altering to chlorite have been monitored as a function of time from 16 hydrothermal granite-water experiments conducted at the following conditions: T = 170° - 300°C; P = 100-300 bars; mNaCl = 0.1-1.0; water/biotite mass ratio = 1-60 for periods up to 900 hours. The magnitude of $\delta^{18}O$ depletion in biotite increased with increasing temperature and time. Detailed thin section, x-ray and SEM studies demonstrated that biotite is altered exclusively to chlorite in 11 of the 16 experiments. The amounts of chlorite formed in these experiments increased with increasing temperature as well as time. The isotopic compositions of chlorite were calculated from mass balance, and compared with the final measured $\delta^{18}O$ of the fluids. These fractionations ($\Delta$Ch1-w) average 0.26, 0.77, and 3.74 per thousand for T = 300°, 250°, and 200°C, respectively. Several lines of evidence will be discussed that suggest these data may represent equilibrium values. A least-squares regression of the data yields the following preliminary equation: 1000 ln $\alpha$/sub/ Chl-W/ = 08.38 ($10^3$/T) + 4.81 ($10^6$/$T^2$). The error about this curve is at least +/- 0.5 per thousand at 250° and 300°C, and +/- 1 per thousand at 200°C. There is excellent agreement between this curve and the curve given by Wenner and Taylor (1971) for the temperature range of 250° to 300°C. However, below 250°C, the new chloride-water results predict consistently higher temperatures compared to previous estimates.

**9624 Formation constants for aqueous ferrous acetate complexes from magnetite solubility measurements from 100° to 250°C and 250 to 1250 bars.** Drummond, S.E.; Palmer, D.A. (Oak Ridge National Laboratory, TN (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 567(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

The authors previous results on the kinetics of acetate decarboxylation demonstrated that acetate is sufficiently stable below 300° to be effective in transporting metals in hydrothermal solutions by enhancing the solubility of minerals through complexation. The overall reaction studied to evaluate metal-acetate formation constants is expressed by the general equations: $Fe_3O_4$ (magnetite) + $2CH_3COOH \rightleftharpoons Fe(CH_3COO)$/sub n//sup 2-n/ + (2-n)$CH_3COO$- + $H_2O$ + $Fe_2O_3$ (hematite) [1]. The experiments, which cover a compositional range from .03-.70 m acetate and .01-.20 m acetic acid, indicate that $FeCH_3COO^+$ (n=1) predominates up to 150° but is subordinate to $Fe(CH_3COO)_2$ (n = 2) at higher temperatures. The data have a precision of +/- 10%. $\Delta V$ for reaction 1 is about -34 cc/mol when n = 1 (150°) and ranges from -45 cc/mol (200°) to -51 cc/mol (250°) when n=2. Elimination of the redox and hydrolysis equilibria from reaction [1] allows the complex formation to be expressed simply: $Fe^{2+}$ + n$CH_3COO$- $\rightleftharpoons$ Fe($CH_3OO$)/sub n//sup 2-n/ [2]. Inasmuch as these formation constants are 2-3 orders of magnitude greater than current estimates for the corresponding ferrous-chloride complexes, it is quite likely that acetate complexing accounts for the majority of iron and perhaps other metals in many hydrothermal solutions below 300°. This concept is particularly attractive in environments where other ligands are insufficient to account for the metals in solution and where there is a source for acetate. Oil and gas field waters, Mississippi-Valley and Carlin-Gold ore solutions are among the likely candidates.

**9625 Sm-Nd isotopic study of Precambrian/Cambrian sedimentary provenance in the Great Basin and implications for the tectonic evolution of the western US.** Farmer, G.L. (Los Alamos National Lab., NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 578(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

The Nd isotopic compositions and Sm-Nd model ages were determined for 14 Precambrian to Cambrian clastic miogeoclinal and 2 Lower Paleozoic eugeoclinal metasedimentary rocks in the Great Basin to determine the sediment source regions and constrain the tectonic evolution of the western margin of the continental US Upper Precambrian (McCoy Creek Group-MCG) and Lower Cambrian miogeoclinal sandstones and shales have homogeneous 147SM/144Nd values (.110 to .119) but show a regional variation in measured $\epsilon$/sub Nd/, from values of -18 and -26 (T/sub DM/=1.9 and 2.5Ga) in the Pilot and Ruby Ranges in N. Nevada, to values clustering at -11 and -18 (T/sub DM/=1.3 and 1.9Ga) in the Deep Creek and Schell Creek Ranges in the east-central Great Basin. The isotopic variations in the MCG correspond spatially to changes in the $\epsilon$/sub ND/(0) and T/sub DM/ Precambrian basement adjacent to the miogeocline, suggesting that the MCG were derived from these crustal terranes and were deposited close to the paleocontinental margin of the western US. An $\epsilon$/sub Nd/(0)=22.14 (T/sub DM/=2.1 Ga) for deeper water miogeoclinal sediment in the southern Great Basin (Wyman Fm-White Mountains, California) requires a source either in nearby T/sub DM/=2.2Ga crust in the S. Sierra Nevada (Bennett and DePaolo, 1984), or in T/sub DM/ >2.0Ga crustal terranes to the north, with the sediment having been transported southward via Precambrian longshore currents. Feldspathic sandstone of the Cambrian Harmony Formation in north-central Nevada has $\epsilon$/sub Nd/(0)=-25.22 (T/sub DM/ =2.4Ga), consistent with a northerly source in Archean crust of present-day Idaho, while Ordovician shale of the Vinini Fm. in central Nevada has $\epsilon$/sub Nd/(0)=-17.6, identical to values for the MCG exposed directly to the east.

## 5805 Oceanography

*REFER ALSO TO CITATION(S) 9289*

**9626 (CONF-8810250—1) Indication of changes in ocean ventilation rates in $^{14}C/^{12}C$ record of tree-ring and of deep sea sediment.** Peng, T.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004164/JAW.

From EPRI conference on interaction of the global carbon and climate systems; Lake Arrowhead, CA, USA (23 Oct 1988).

Published $^{14}C$ data for atmospheric $CO_2$ indicate a net decrease of 100{degree}/oo over the last 8000 years. The decrease has generally been interpreted as a consequence of changing atmospheric $^{14}C$ production rates caused by changes in the magnetic field of the earth. This paper discusses changes in the ocean ventilation rate as another possible cause. The rate of ocean ventilation in the past can be derived from the $^{14}C$ record preserved in planktonic and benthic foraminifera in deep sea sediments, assuming that the $^{14}C/C$ ratio in these foraminifera shells represents the $^{14}C/C$ ratio of the total dissolved carbon in the surface water and the deep water, respectively, in the past. Results of radiocarbon dating, using accelerator mass spectrometry on handpicked planktonic and benthic foraminifera in deep sea sediments from the South China Sea, show that the age differences between planktonic (G. sacculifer) and benthic foraminifera increase from 1350 years about 7000 years ago to 1650 years at present. The preanthropogenic $^{14}C$ age difference of dissolved inorganic carbon between bottom water and surface mixed layer water in South China Sea is 1585 +- 150 years. An 11-box geochemical model of global ocean circulation is used for studying changes in ocean ventilation rates. Both tree-ring-determined atmospheric $^{14}C$ values and foraminifera $^{14}C$ age differences are used as constraints to place limits on patterns of changes in ocean ventilation rates and in atmospheric $^{14}C$ production rates. 17 refs., 7 figs.

**9627 (DOE/ER/60311—4) Nutrient recycling on the southeastern US continental shelf: Progress report, March 1, 1985--February 28, 1988.** Hanson, R.B. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1988. Contract FG09-85ER60311. 34p. NTIS, PC A03 - OSTI. Order Number DE89003697/JAW.

FLEX (Fall removal experiment) and BIOTRANS (Biological Transformation Study) field studies were completed during the present contract year. Sample processing and some data analysis are underway. Nitrogen recycling data from SPREX is published. Bacterioplankton data from SPREX and PRESPREX are in press. Nitrogen recycling data from GALE is still being analyzed. Nitrogen recycling rates and chemistry from the SPREX experiment show that rates of $NH_4$ regeneration could support 29 to 127% of the measured photosynthesis. Ammonia assimilation was 10 to 20% of measured photosynthesis. Our results show that alternative nitrogen sources are necessary to meet nitrogen requirement of coastal phytoplankton. Nitrogen cycling rates and chemistry, bacteria, and biological transformations from the FLEX experiment are partially completed. Some results are given in this document. On the GALE Cruise, nitrogen recycling rates and chemistry during Atlantic lows (storms) is partially completed. Data processing and analysis of N15 samples still continues. During coastal stratification (PreSPREX), bacterioplankton covaried with phytoplankton distribution and averaged 35% (coastal) and 81% (midshelf) of the phytoplankton biomass. When coastal waters were vertically homogeneous (SPREX), bacterioplankton ranged 2-3% of the phytoplankton biomass. The ecological implications of these results are discussed.

**9628 (DOE/ER/60333—5) California Basin Study (CaBS): Circulation and particle fluxes in the southern California Bight: Annual progress report, 15 November 1987--14 November 1988.** Hickey, B. (Washington Univ., Seattle (USA). School of Oceanography). 1988. Contract FG05-85ER60333. 53p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004736/JAW.

During this period we have executed three CTD/oxygen/transmission surveys, during 1-7 Feb (SHELF 1), 5-12 April (SHELF 2), and 1-9 Oct (SHELF 3). Data were obtained at 78, 70, and 109 stations, respectively. Calibration of these data sets has been completed and processing has been initiated. The SHELF 2 and SHELF 3 cruises also included shipboard acoustic Doppler current surveys. Cruise reports for the three cruises are appended. During February we successfully deployed several moorings in an array designed to monitor the important seasonal transition between winter and spring (TRANSITION). In April, additional moorings were added to the array to provide a detailed description of circulation over the Santa Monica shelf (SHELF). Rationale for and details of these experiments are described below. All moorings except one and a half were successfully fishermen earlier in the season and were returned to us intact. One mooring in the October cruise failed to release and was recovered via a submersible the next day. The malfunction was due to the fact that the release mechanism of the mooring, which had been deployed for nine months in 30 m of water, was jammed with rock scallops! 9 refs., 10 figs., 8 tabs.

**9629 (DOE/ER/60333—6) DOE West Coast environmental studies: Circulation and particle fluxes in the Southern California Bight: Report of progress, May 15, 1985--November 15, 1988.** Hickey, B. (comp.). (Washington Univ., Seattle (USA). School of Oceanography). 1988. Contract FG05-85ER60333. 337p. NTIS, PC A15/MF A01 - OSTI. Order Number DE89004735/JAW.

The overall objective of the DOE West Coast Basin study (CaBS) is to understand the dispersion of potential contaminants from inshore waters, where they may primarily be generated, across the shelf out to deeper waters; in particular, the role of particulate fluxes, determination of general pathways of material removal, residence times, and water column/sediment exchanges. The CaBS program differs significantly from the other DOE marine programs. In most East Coast regions, anthropogenic material is either swept away from the coastal zone by the high energy physical environment or, if it is sedimented out of the water column, is reworked by organisms to such an extent that accurate estimates of particulate fluxes cannot be obtained. The deep basins off the Cali-

fornia coast, on the other hand, provide relatively efficient traps for anthropogenic material introduced into the coastal zone. Moreover, since the basins are anoxic, or nearly so, reworking of sediments by marine organisms is minimized, so that accurate estimates of sediment accumulation rates and recycling processes can be obtained. Specific questions to be addressed include (1) to what extent can the coastal basins safely absorb potentially harmful energy-related anthropogenic materials? and (2) to what extent do anthropogenic materials introduced into the basins find a pathway back to man? The long-term goals of the Hickey component of CaBS are to investigate (1) circulation in the Southern California Bight, including both patterns and forcing mechanisms, and (2) particle dynamics in this region; in particular, the relative importance of horizontal advection, wave/current resuspension processes, and intermediate-depth nepheloid layers, in redistributing particles, on time scales of minutes to seasons. 9 refs., 40 figs.

9630 **(DOE/ER/60340—6) California Basin Study (CaBS): [The role of zooplankton and micronektron in the cycling and remineralization of chemical materials in the Southern California Bight]: Progress report 6, May 1985--November 1988.** Small, L.F.; Huh, Chih-An. (Oregon State Univ., Corvallis (USA). Coll. of Oceanography). 1988. Contract FG05-85ER60340. 41p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004737/JAW.

The overall objective of Phase-I of our research, within the structure of the DOE CaBS (California Basin Study) program, has been to understand the transport pathways and mass balances of selected metabolically active and inactive chemical species in the Santa Monica/San Pedro (SM/SP) Basins. During Phase-I, Drs. L.F. Small and C.-A. Huh were part of the same proposal, and so this progress report reflects our joint effect over the first three years of the CaBS program. One focus of our study has been to examine the role of zooplankton in the cycling and remineralization of chemical materials in the Southern California Bight, with particular reference to C, N and certain radionuclides and trace metals. A second focus has been to examine these same radionuclides and trace metals in other important reservoirs (i.e., in seawater, sediment trap material and bottom sediments). Knowledge of the rates and routes of transfer of these nuclides and metals through these reservoirs should lead to a cogent model for these elements in SM/SP Basins. Our zooplankton C and N data, in conjunction with primary production, microbiological and sediment trap data from colleagues in the program, has led to a model of C and N cycling in the upper water column. Our sediment core data (chronologies and chemical profiles), together with sediment trap and benthic flux data, has resulted in the construction of an organic carbon mass balance in the SM/SP Basins. Both efforts are first attempts (see Appendices), but we have been heartened by the reasonableness of these first attempts after just three years of data. 29 refs., 13 figs., 5 tabs.

9631 **(FO/CAR—8803) Seasonal salinity, temperature and density data for the Canadian Beaufort Sea shelf, 1987.** Hopky, G.E.; Chiperzak, D.B.; Lawrence, M.J. (Department of Fisheries and Oceans, Winnipeg, Manitoba (Canada). Central and Arctic Region). 1988. 155p. (MICROLOG—88-03404). Canada Dept. of Fisheries and Oceans, Scientific Information and Publications Branch, 200 Kent Street, 12th. Floor, Ottawa, Ont., Canda K1A 0E6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report contains salinity, temperature and density (CTD) data collected in the waters of the Canadian Beaufort Sea Shelf during 1987. A major objective of such data collection is to identify and characterize estuarine and marine habitats of significance to the biological communities, primarily fish, with a view to provide background data for assessing the implications of hydrocarbon development and production on those habitats. Salinity and temperature profile data were measured using a Guildline Model 8870 probe deployed from the ice surface in March and May, and from a ship during July to September. Ice thickness and secchi depth were measured during periods of ice cover and open water, respectively. Salinity values for samples collected from bottle casts were measured with an Autosal Model 8400 salinometer. Density was calculated using salinity and temperature values. During the ice cover periods of March and May, CTD profiles were measured at five and nine stations, respectively. For the open water July to September period, CTD profiles were measured at 41 stations. One additional station was sampled using bottle casts. Replicate CTD profiling was conducted at a number of stations, on a seasonal basis. The maximum depths of profiles measured from the ice surface ranged from 3.1 to 23.5 dbar. Salinity and temperature measurements ranged from 0.00 to 31.70, and -1.74 to 0.02/sup 0/C, respectively. Maximum depths of profiles measured during the open water period ranged from 2.9 to 196.4 dbar. During this same period, profile measurements of salinity and temperature ranged from 0.08 to 33.94, and -1.62 to 16.51/sup 0/C, respectively. 4 refs., 60 figs., 57 tabs.

9632 **(PHRI—612) Annual report on wave properties at the network stations(1986).** Kobune, Koji; Kameyama, Yutaka; Narita, Akira; Sugahara, Kazuteru; Goto, chiaki; Hashimoto, Noriaki. (Port and Harbour Research Inst., Yokosuka (Japan)). Mar 1988. 249p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01 - Available from The Port and Harbour Research Institue, 1-1-3, Nagase, Yokosuka, Japan. Order Number DE88755749/JAW.

Since 1970, the Port and Harbor Research Institute has been cooperated with the Bureau of Port and Harbors, Ministry of Transport, and its associated agencies, on the costal wave observation at their network stations in Japan. The P.H.R.I. has been processed and analyzed the wave records obtained at these stations, and has published the wave statics in a series of reports (up to 1979, the title of the reports were Annual Report on Wave Observation at Chosen Points). This technical note is the 1986 version of the series, and covers the wave data obtained throughout 1986 at 35 network stations in Japan. The annual statistics show that the average wave heights over the year are almost the same as those of normal years throughout the country. With respect to the monthly average, the wave heights larger than those observed in normal years are recorded in pacific coastal areas in March. On the other hand the wave heights in the Northern part of Japan Sea were larger in November. The records of largest significant waves were renewed at Fukaura (H1/3=10m, T1/3=11.1s) and kamaishi. (45 figs, 24 tabs, 28 refs)

# 64 PHYSICS I

*REFER ALSO TO CITATION(S) 9939, 9941*

9633 **(JINR—R-15-87-288) Proceedings 3. Seminar of yound scientist of JINR in region of experimental physics.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 43p. (In Russian). (CONF-8604409—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780047/JAW.

From 3. seminar of young scientist of JINR in region of experimental physics; Dubna, USSR (1 Apr 1986).

Individual papers in these proceedings are abstracted separately.

## 6401 Astrophysics And Cosmology

*REFER ALSO TO CITATION(S) 9757, 9831, 9842, 9867, 9913, 9917, 9918, 9924, 9937*

9634 **(AD-A—197232/2/XAB) Radiative association via excited electronic states: model calculations.** Herbst, E.; Bates, D.R. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics and Theoretical Physics). 1 Jun 1988. 10p. NTIS, PC A02/MF A01.

Pub. in Astrophysical Jnl., Vol. 329, No. 1, 410-417(1 Jun 1988).

In recent years, a variety of rate coefficients were calculated for radiative association reactions (A(+)+B yield A(+)B+hnu) thought to be important in the chemistry of both dense and diffuse interstellar clouds. In the majority of these calculations, radiative association proceeded via an intermediate complex A(+)B which exists in the vibrational quasi-continuum of the ground electronic

state and radiates sufficient energy for stabilization in the infrared via vibrational transitions. However, recent experimental work on one important system ($CH_5^+ + H_2$ yield $CH_5^+ +$ hnu) indicates that in order to reconcile theory and experiment, the required rate of radiative stabilization must be more than an order of magnitude greater than can be explained by vibrational emission. Consequently, stabilization via formation of a complex in one electronic state followed by rapid electronic emission to stable vibrational levels of a second electronic state must be invoked. If electronic relaxation is important in one system, it may well be important in a number of systems. In this paper, it is shown that the existence of low-lying electronic states of species produced in radiative association reactions can lead to enhancements of rate coefficients previously calculated by factors of 10-100. However, the lack of available information on the positions and transition dipoles of such excited states makes definitive statements on the importance of this mechanism premature.

**9635 (AD-A—197701/6/XAB) Proton flares of 1980-1986. Final technical report, 1 March-31 December 1987.** Zirin, H. (California Inst. of Tech., Pasadena (USA)). Nov 1987. 5p. NTIS, PC A02/MF A01.

Proton flares from 1980 through May 1986 were studied. The particle events (having proton flux of 10/sq cm/s/sr with energy > or = 10 MeV) and their associated flares are published by the NOAA Space Environment Service Center in the Solar Geophysical Data. A total of 39 proton events occurred during the time interval, of which 34 associated source flares were identified. Aspects of the 34 proton flares investigated in the study and the results are listed below: Active Regions in which Proton Flares Occurred; Proton Flares and Flares Associated with Interplanetary Type II Bursts; Hard X-ray Signatures; and The Proton Flare Scenario.

**9636 (AD-A—197872/5/XAB) Chemical pathways for deuterium fractionation in interstellar molecules.** Henchman, M.; Smith, D.; Adams, N.; Paulson, J.F.; Lindinger, W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1988. 9p. (AFGL-TR—88-0173). NTIS, PC A02/MF A01.

Pub. in Rate Coefficients in Astrochemistry, 201-207(1988).

The formation of deuterated interstellar molecules is considered. This contribution (which, in the summarizing remarks of the conference, was admonished for being itself admonitory) has a simple purpose - to apply gas-phase ion chemistry to distinguish deuterium exchange reactions that can occur from those that cannot. Thus the exoergic reaction HCO(+) + D yield DCO(+) + H is facile whereas the exoergic reaction HCO(+) + HD - x yield DCO(+) + $H_2$ is not. Forbidden pathways involve energy barriers that can result from both reactants showing filled valence electron shells. A procedure is outlined for identifying such.

**9637 (AD-A—198208/1/XAB) MHD (magnetohydrodynamic) modeling of energy buildup due to photospheric shearing motion and its relation to flare-prediction criteria. Final report, November 1982-September 1985.** Wu, S.T.; Smith, J.B. (Alabama Univ., Huntsville (USA). Dept. of Mechanical Engineering). 22 Sep 1987. 93p. NTIS, PC A05/MF A01.

An investigation of the evolution of active regions, leading to the buildup and storage of magnetic energy for eventual rapid release as the thermal, radiative, and kinetic energy of solar flares is presented. This investigation is based on both observations and theoretical models. Solar observations utilized in the study were vector magnetograms, high-resolution hydrogen-alpha filtergrams, flare data, and sunspot pictures (for the energy-buildup model). Parameters selected for the initial analysis, generally indicative of (available) magnetic energy buildup, include (1) the angle of shear, (2) the strength of the sheared field, (3) the longitudinal gradient (4) a parameter related to the shear volume, and in an observationally limited number of cases, (5) the data sample considered, significant flare production correlates well with indications of strong magnetic shear and energy storage. The theoretical models are based on magnetohydrodynamic theory. Specifically, a two-dimensional, non-planar, time-dependent MHD model was used to deduce the critical parameters as eventual input to a proposed shear/flare index . However, these theoretically deduced physical parameters have to date had only limited comparison with observations. This combined theoretical and observational study could lead to the development and refinement of a magnetic shear/flare index for the improvement of solar-flare-prediction technology.

**9638 (AD-A—198602/5/XAB) Magnetic properties of C IV Doppler-shift patterns.** Klimchuk, J.A. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Apr 1988. 31p. (CSSA-ASTRO—88-12). NTIS, PC A03/MF A01.

The relationship between Doppler-shift patterns observed in the transition region and magnetic-field patterns observed in the photosphere is studied using coaligned pairs C IV Dopplergrams and Fe I magnetograms. Categories of magnetic features are defined--including neutral lines, unipolar regions, strong-field regions, weak-field regions, and magnetic boundaries--and from these, magnetic associations are determined for 159 V0 lines separating areas of relative blueshift and redshift observed in and nearby to active regions. The cases are subdivided on the basis of whether blueshifts or redshifts are observed on the side of the V0 line nearest the limb. Two of the main results are that V0 lines associated with neutral lines tend to have limbward blueshifts, while V0 lines associated with unipolar regions tend to have limbward redshifts. These and other results provide supportive evidence for the active-region model proposed recently by Klimchuk, in which relative redshifts occur where strong vertical fields penetrate the surface, and relative blueshifts occur where these same fields have spread out to become horizontal. It is likely that the relative blueshifts correspond to absolute Doppler shifts of very small amplitude, possibly even redshifts.

**9639 (AD-A—199148/8/XAB) Radiative association.** Bates, D.R.; Herbst, E. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics and Theoretical Physics). 1988. 25p. NTIS, PC A03/MF A01.

Pub. in Rate Coefficients in Astrochemistry, 17-40(1988).

Radiative-association reactions are reactive processes in which two smaller gas-phase species collide to form a larger molecule while emitting a photon. These reactions are thought to be important in the synthesis of molecules in both diffuse and dense interstellar clouds. Models of interstellar clouds require the rate coefficients of a variety of radiative-association reactions as input, yet few experimental studies of these processes have been undertaken. Therefore, the role of theory in the determination of radiative-association rate coefficients is paramount. Most experimental studies of association reactions are at sufficiently high pressure that the mechanism for association is collisional rather than radiative. Yet even collisional (ternary) association studies yield valuable information about radiative-association processes. This review considers the nature of association reactions - both radiative and ternary - and discussed experimental and theoretical approaches to the determination of rate coefficients of radiative-association reactions.

**9640 (AD-A—199379/9/XAB) Directionality of continuum gamma rays from solar flares.** Bai, T. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Apr 1988. 19p. (CSSA-ASTRO—88-02). NTIS, PC A03/MF A01.

The hard-x-ray spectrometer total counts are used as calibration to investigate how the brightness of gamma rays above 300 keV changes as a function of the heliocentric angle of a flare. The normalized gamma-ray brightness, on the average, increases with the heliocentric angle; a flare at the limb is estimated to be 13 times brighter in gamma rays than a similar flare near the central meridian. Both pancake-like electron distributions and downward beam distributions can be adjusted to produce the deduced limb brightening.

**9641 (AD-A—199380/7/XAB) Spectral analysis of the Elatina varve series.** Bracewell, R.N. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Feb 1988. 24p. NTIS, PC A03/MF A01.

The Elatina formation in South Australia, which provides a rich fossil record of presumptive solar activity in the late Precambrian, is of great potential significance for the physics of the sun

because it contains laminae grouped in cycles of about 12, an appearance suggestive of the solar cycle. The actual spectrum of the lamina-thickness series is rather complex, 20 or more spectral lines having been recognized by Fourier analysis. It is shown how these numerous lines arise as combination frequencies, from a much simpler intrinsic spectrum, by rectification. Optical studies of the sun have shown that there is a magnetic polarity reversal on the sun every 11 years approximately, but terrestrial consequences of solar activity, for example in the ozonosphere or ionosphere, do not respond to solar magnetism; thus the negative-going semicycles of the full magnetic cycle are, in effect, rectified. Application of this knowledge to the Elatina formation shows that directification simplifies the spectrum of the lamina-thickness series in exactly the way that one would expect if the solar cycle were at work here also.

**9642 (AD-A—199486/2/XAB) Rapid acceleration of energetic particles in the 1982 February 8 solar flare.** Kane, S.R.; Chupp, E.L.; Forrest, D.J.; Share, G.H.; Rieger, E. (New Hampshire Univ., Durham (USA). Dept. of Physics). 15 Jan 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Astrophysical Jnl., Vol. 300, L95-L98(15 Jan 1986).

Hard x-ray and gamma-ray measurements of the 1982 February 8 (about 1250 UT) solar flare made with spectrometers aboard the ISEE 3 and SMM spacecraft show that bursts of photons from about 40 keV to about 40 MeV are coincident to within + or - 1 s. This indicates that the acceleration of particles to relativistic velocities can occur promptly (within about 1 s). As far as the energetic particles interacting at the Sun are concerned, the two-phase process, which requires several minutes for particle acceleration to relativistic velocities, cannot account for the present gamma-ray observations. Even the two-step acceleration process, which is assumed to occur in a small magnetic loop, is severely constrained by the present observations.

**9643 (AD-A—199487/0/XAB) Solar-neutron emissivity during the large flare on 1982, June 3.** Chupp, E.L.; Debrunner, H.; Fluckiger, E.; Forrest, D.J.; Golliez, F. (New Hampshire Univ., Durham (USA). Dept. of Physics). 15 Jul 1987. 14p. NTIS, PC A03/MF A01.

Pub. in Astrophysical Jnl., Vol. 318, 913-925(15 Jul 1987).

Observations made with the gamma-ray spectrometer (GRS) on the Solar Maximum Mission (SMM) satellite and with the Jungfraujoch neutron monitor are used to determine the directional solar-neutron emissivity spectrum from about 100 MeV to about 2 GeV during the solar flare on 1982 June 3. The experimental data require a time-extended emission of the neutrons at the Sun with the majority of the neutrons produced after the impulsive phase. Fits to the observational data are provided by neutron emissivity spectra with spectral forms (E sub n) to the -2,4 power and (E sub n) to the 3/8 power exp (4th root(E sub n)/0.016). The power-law form requires a truncation at energy E sub c, where 2 GeV < E sub c < 4 GeV. In both cases the integrated neutron emissivity for energies greater than 100 MeV is about $10^{28}$ neutrons 1/sr. These high-energy spectra are in agreement with the neutron spectrum for energies less than 100 MeV derived from observations of neutron-decay protons. The observations also require that the first GeV protons producing the GeV neutrons interacted at the Sun within a time span of at most 16s implying neutron production at densities n > $10^{14}$/cc. Also considered are the observational effects of high-energy neutron spectral changes throughout this event. This analysis of the neutron data for E sub n > or = 100 MeV is unable to differentiate between isotropic and nonisotropic emission of the neutrons.

**9644 (AD-A—199499/5/XAB) Directivity of high-energy emission from solar flares: solar-maximum mission observations.** Vestrand, W.T.; Forrest, D.J.; Chupp, E.L.; Rieger, E.; Share, G.H. (New Hampshire Univ., Durham (USA). Dept. of Physics). 15 Nov 1987. 15p. NTIS, PC A03/MF A01.

Pub. in Astrophysical Jnl., Vol. 322, 1010-1022(15 Nov 1987).

The data base consisting of flares detected by the gamma-ray spectrometer (GRS) on board the Solar Maximum Mission (SMM) satellite is used to study the directivity of high-energy radiation. A number of observations strongly indicate that the high-energy emission from flares is anisotropic. They are the following: the fraction of events detected at energies > 300 keV near the limb is higher than is expected for isotropically emitting flares; there is a statistically significant center-to-limb variation in the 300-keV to 1-MeV spectra of flares detected by the SMM GRS; the 25-200 keV hard x-ray spectra measured during the impulsive phase by the SMM GRS show a center-to-limb variation; and nearly all of the events detected at > 10 MeV are located near the limb. Then these observations are best explained by models in which nonthermal electrons radiate in a thick-target emission region lower in the atmosphere. To produce the observed center-to-limb variations, one needs an electron distribution that has an intensity which increases with angle from the outward normal. Candidate distributions are downwardly directed Gaussian beams and pancake distributions that peak in directions parallel to the photosphere. During the impulsive phase of the flare this nonthermal component seems to be visible down to energies less than 40 keV. These results imply that the procedure normally used to deduce the properties of flare-accelerated electrons from hard x-ray and gamma-ray observations an substantially underestimate the spectral hardness and number of high-energy electrons. Another consequence is that, on the average, disk flares should appear to be richer in nuclear emission than limb flares.

**9645 (AD-A—199509/1/XAB) Directivity of 100 keV-1 meV photon sources in solar flares.** Kane, S.R.; Fenimore, E.E.; Klebesadel, R.W.; Laros, J.G. (California Univ., Berkeley (USA). Space Sciences Lab.). 15 Mar 1988. 16p. (AFGL-TR—88-0226). NTIS, PC A03/MF A01.

Pub. in Astrophysical Jnl., Vol. 326, 1017-1031(15 Mar 1988).

Stereoscopic observations of 0.1-1.0 MeV photon sources in solar flares made with spectrometers aboard the ISEE 3 (Third International Sun Earth Explorer) and PVO(Pioneer Venus Orbiter) were analyzed to determine the directivity of the photon sources and its possible dependence on photon energy. During the period 1978 October 1-1980 October 31, a total of 44 solar flares were observed simultaneously by the two instruments. Of these, 39 flares were in full view of both the instruments, the remaining five being partially occulted by the photosphere from the line of sight of at least one instrument. The view angles theta and theta of the PVO and ISEE 3 instruments with respect to the outward solar radius at the flare site varied from one flare to another and were in the range 9-88. The difference theta - theta 1 between the two view angles varied from 1 to 66. The observations of differential photon energy spectra averaged over > or = 16 s do not indicate any systematic directivity. In most flares the directivity j (theta = 90)/ j(theta = 0) of 0.1-1.0 MeV photon sources is found to be < or = 2.5.

**9646 (AD-A—199577/8/XAB) Propagation and confinement of energetic electrons in solar flares.** Kane, S.R. (California Univ., Berkeley (USA). Space Sciences Lab.). 1987. 21p. NTIS, PC A03/MF A01.

Pub. in Solar Physics, Vol. 113, 145-164(1987).

The propagation, confinement, and total energy of energetic (>25 keV) electrons in solar flares are examined through a brief review of the following hard x-ray measurements: (1) spatially resolved observations obtained by imaging instruments; (2) stereoscopic observations of partially occulted sources providing radial (vertical) spatial resolution; and (3) directivity of the emission measured through stereoscopic observations and the center-to-limb variation of the occurrence frequency of hard X ray flares. The characteristics of the energetic electrons are found to be quite distinct in impulsive and gradual hard x-ray flares. In impulsive flares, the nonthermal electron spectrum seems to extend down to about 2 keV indicating that the total energy of nonthermal electrons is much larger than that assumed in the past.

**9647 (DOE/ER/40427—20-N8) Neutral currents, supernovae neutrinos, and nucleosynthesis.** Haxton, W.C. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 8p. (CONF-880639—7). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004565/JAW.

From International conference on contemporary topics in nuclear structure physics; Cocoyoc, Mexico (9 Jun 1988).

The inelastic interactions of neutrinos during stellar collapse and neutron star cooling are discussed. The primary mechanism for dissipative neutrino reactions is nuclear excitation by neutral current scattering, a process not included in standard descriptions of supernovae. Charge-current and neutral current "preheating" of iron lying outside the shock front appears to be significant in the few milliseconds near shock breakout. This could help produce a more energetic shock. During the cooling phase, the neutral current interactions of muon and taon neutrinos appear to be responsible for some interesting nucleosynthesis. I discuss two examples the production of fluorine and neutrino-induced r-process nucleosynthesis. 26 refs., 1 fig., 3 tabs.

9648 **(INS—699) Pregeometry and prephysics.** Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756045/JAW.

A possible origin of the big bang and a possible meaning of the spacetime dimensions are discussed in pregeometry and prephysics. Some relations between pregeometry and superstring theories are also discussed.

9649 **(LA—11431-T) Study of ultra-high energy emission from Cygnus X-3 and Hercules X-1.** Dingus, B.L. (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 160p. NTIS, PC A08 - OSTI. Order Number DE89004543/JAW.

The CYGNUS experiment, consisting of an extensive air shower detector and a muon detector, was built at Los Alamos, New Mexico (latitude 36 N, longitude 107W, altitude 2310 meters), to search for point sources of ultra-high energy ($>10^{14}$ eV) particles. These particles must be long-lived neutral particles because of the long source distances and the presence of the intragalactic magnetic field. Gamma rays are the most likely candidates because of the short neutron lifetime and the small neutrino cross section. Therefore, the muon content of the source showers is examined to determine if these events are muon poor as is expected for gamma-initiated showers. The data set from April 1986 to July 1987 is searched for continual emission from Cygnus X-3 and Hercules X-1, and an upper bound to flux is determined for both sources. The flux limit for Cygnus X-3, 2.0 {times} 10/sup {minus}13/ cm/sup {minus}2/ sec/sup {minus}1/ above 50 TeV, is lower than previous ultra-high energy observations. Hercules X-1 has never been observed continually at ultra-high energies. Cygnus X-3 is observed for a shorter interval of time, beginning on 17 April 1986 and ending 1 June 1986. There is one chance in 300 that the observation is due to a random fluctuation. The signal is correlated with the 4.8 hour orbital period, and the muon content of the showers in the signal is inconsistent with the conventional prediction of gamma-initiated showers. An episodic signal is also reported for Hercules X-1, and it consists of two bursts of less than one hour duration on 24 July 1986. The probability is one chance in 12,000 that this observation is not associated with Hercules X-1. The signal is pulsed at frequency near, but significantly different from, the x-ray pulsar frequency. The muon content of the signal showers is also anomalous, assuming the showers are initiated by gamma rays. 62 refs., 60 figs.

9650 **(N—88-29652) Catalog of open clusters and associated interstellar matter.** Leisawitz, D. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1988. 294p. (NASA-RP—1202; REPT—88B0152; NAS—1.61:1202). NTIS, PC A13/MF A01.

The Catalog of Open Clusters and Associated Interstellar Matter summarizes observations of 128 open clusters and their associated ionized, atomic, and molecular iinterstellar matter. Cluster sizes, distances, radial velocities, ages, and masses, and the radial velocities and masses of associated interstellar medium components, are given. The database contains information from approximately 400 references published in the scientific literature before 1988.

9651 **(N—88-29653) Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres. Semiannual status report, 1 February-31 July 1988.** Steffes, P.G. (Georgia Inst. of Tech., Atlanta (USA)). 1988. 37p. (NASA-CR—182443; NAS—1.26:182443; SASR—9). NTIS, PC A03/MF A01.

In the first half of this grant year, laboratory measurements were conducted on the millimeter-wave properties of atmospheric gases under simulated conditions for the outer planet. Significant improvements in the current system have made it possible to accurately characterize the opacity from gaseous $NH_3$ at longer millimeter wavelengths (7 to 10 mm) under simulated Jovian conditions. In the second half of the grant year, it is hoped to extend such measurements to even shorter millimeter-wavelengths. Further analysis and application of the laboratory results to microwave and millimeter-wave absorption data for the outer planets, such as results from Voyager Radio Occultation experiments and earth-based radio astronomical observations will be continued. The analysis of available multispectral microwave opacity data from Venus, including data from the most recent radio astronomical ovservations in the 1.3 to 3.6 cm wavelength range and newly obtained Pioneer-Venus Radio Occulatation measurements at 13 cm, using the laboratory measurements as an interpretative tool will be pursued.

9652 **(N—88-30201) Workshop on the Growth of Continental Crust.** Ashwal, L.D. (Lunar and Planetary Inst., Houston, TX (USA)). 1988. 174p. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—). NTIS, PC A08/MF A01.

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Constraints and observations were discussed on a fundamental unsolved problem of global scale relating to the growth of planetary crusts. All of the terrestrial planets were considered, but emphasis was placed on the Earth's continental crust. The title of each session is: (1) Extraterrestrial crustal growth and destruction; (2) Constraints for observations and measurements of terrestrial rocks; (3) Models of crustal growth and destruction; and (4) Process of crustal growth and destruction.

9653 (N—88-30201, pp 29-30) **Constraints on continental accretion from sedimentation.** Abbott, D. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Heat loss in the ancient Earth was discussed assuming that classical sea floor spreading was the only mechanism. This may be expressed as faster spreading or longer total ridge length. These have important implications as to the size and number of cratonic plates in the distant past, the degree to which they are flooded, the kinds of sediments and volcanics that would be expected, and the amount of recycling of continental material taking place. The higher proportion of marine sedimentary rocks and oceanic volcanics in the Archean, and the relative paucity of evaporites and continental volcanics may in part be due to smaller cratonic blocks. A model was developed of the percentage of continental flooding which utilizes round continents and a constant width of the zone of flooding. This model produces a reasonable good fit to the percentage of flooding on the present day continents.

9654 (N—88-30201, pp 33-34) **Nd isotopes and crustal growth rate.** Albarede, F. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Sm/Nd isotopic constraints on crustal growth is discussed. In order to constrain Sm/Nd fractionation between continental crust and depleted mantle, an extensive data base of isotopic measurements (assumed to be adequately representative of continental crust) was compiled. The results imply that the evolution of depleted mantles was roughly linear, with no major discontinuities over the course of geologic time. This is different from other determinations of depleting mantle evolution, which show nonlinear behavior. The Sm/Nd evolution lines for continental crust and depleted

mantle intersect between 3.8 to 4.0 Ga, which may indicate that the onset of continental growth was later than 4.5 Ga. A mathematical model is described, the results of which imply that time integrated crustal additions from the mantle are about 1.8 to 2.5 cu km/a, whereas crustal subtractions by sediment recycling are about 0.6 to 1.5 cu km/a. This results in a net time integrated crustal growth rate of about 1 cu km/a, which is similar to present day rates determined, for example, by Reymer and Schubert.

9655 (N—88-30201, pp 35-37) **Recycling of lower continental crust through foundering of cumulates from contaminated mafic intrusions.** Arndt, N.T.; Goldstein, S.L. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

A mechanism is presented for recycling of lower continental material back into the mantle. Picritic magmas, possible parental to volumious continental volcanics such as the Karoo and Deccan, became trapped at the Moho, where they interacted with and become contaminated by lower crustal materials. Upon crystallization, the magmas differentiated into lower ultramafic cumulate zones and upper gabbroic-anorthositic zones. The ultramafic cumulates are denser than underlying mantle and sink, carrying lower crustal components as trapped liquid, as xenoliths or rafts, and as constituents of cumulate minerals. This model provides a potentially significant crust-mantle differentiation mechanism, and may also represent a contributing factor in crustal recycling, possibly important in producing some OIB reservoirs.

9656 (N—88-30201, pp 38-39) **Growth of continental crust: Clues from Nd isotopes and Nb-Th relationships in mantle-derived magmas.** Arndt, N.T.; Chauvel, C.; Jochum, K.P.; Gruau, G.; Hofmann, A.W. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Isotope and trace element geochemistry of Precambrian mantle derived rocks and implications for the formation of the continental crust is discussed. Epsilon Nd values of Archean komatiites are variable, but range up to at least +5, suggesting that the Archean mantle was heterogeneous and, in part, very depleted as far back as 3.4 to 3.5 Ga. This may be taken as evidence for separation of continental crust very early in Earth history. If these komatiite sources were allowed to evolve in a closed system, they would produce modern day reservoirs with much higher epsilon Nd values than is observed. This implies recycling of some sort of enriched material, perhaps subducted sediments, although other possibilities exist. Archean volcanics show lower Nb/Th than modern volcanics, suggesting a more primitive mantle source than that observed nowadays. However, Cretaceous komatiites from Gorgona island have similar Nb/Th to Archean volcanics, indicating either the Archean mantle source was indeed more primitive, or Archean magmas were derived from a deep ocean island source like that proposed for Gorgona.

9657 (N—88-30201, pp 40-41) **Pluton emplacement and magmatic arc construction: a model from the Patagonian batholith.** Bruce, R.; Nelson, E.; Weaver, S. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

A model of batholithic construction in Andean arcs and its applicability to possibly similar environments in the past is described. Age and compositional data from the Patagonian batholith of southern Chile show a long history of magmatism in any given area (total age range is 15 to 157 Ma), but different regions appear to have different magmatic starting ages. Furthermore, mafic rocks seem to be the oldest components of any given region. An assembly line model involving semicontinuous magmatism and uplift was outlined, which has implications for other terranes: uplift rates will be proportional to observed ranges in age, and total uplift will be proportional to the age of the oldest pluton in any given area. It is suggested that misleading results would be obtained if only small areas of similar terranes in the Archean were available for study.

9658 (N—88-30201, pp 42-44) **Illustration of the complexity of continent formation.** Burke, K. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

It was pointed out that a consensus may be emerging in crustal growth models, considering the clustering of most growth curves and their uncertainties. Curves most distant from this clustering represent models involving extensive recycling of continental material back into the mantle, but the author wondered if geochemical signatures for this would be recognizable considering the lack of evidence from seismic tomography for discrete mantle reservoirs, and the likelihood of core-mantle interaction based on recent high pressure experiments. Unreactivated Archean rocks represent only 2 percent of present continental area, and the author was uncomfortable about basing inferences on what the early Earth was like on such a small amount of information. He feels that the hypothesis of continental assembly that needs testing is that of banging together of island arcs, such as in Indonesia today. As an example of how complex this process can be, the author described the geology of the Caribbean arc system, which shows evidence for reversals of subduction polarity, numerous collisional events, and substantial strike-slip movements. It seemed unlikely to the author that Archean examples would have been less complicated.

9659 (N—88-30201, pp 45-47) **Kerala Khondalite Belt (KKB) of Southern India: an ensialic mobile belt.** Chacko, T.; Meen, J.K.; Kumar, G.R.R.; Rogers, J.J.W. (Centre for Earth Science Studies, Trivandrum (India)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The Proterozoic Kerala Khondalite belt of the Southern Indian Shield is described, a belt dominated by granulite grade (750 C, 5 to 6 kbar) supracrustal rocks whose protoliths included arkoses and shales with cratonic provenances. Rare earth elements and other geochemical signatures suggest a granitic source for these metasediments, possibly the spatially associated charnockite massifs. The presence of intercalated mafic gneisses, interpreted as basalts, implies a cratonic rift basin rather than a foreland basin setting. It was argued that the Kerala, as well as other early Proterozoic mobile belts formed during abortive continental rifting without major additions of new crust.

9660 (N—88-30201, pp 48) **Timing and mechanism of depletion in Lewisian granulites.** Cohen, A.S.; Onions, R.K.; Ohara, M.J. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Large Ion Lithophile (LIL) depletion in Lewisian granulites is discussed. Severe depletions in U, Th, and other LIL have been well documented in Lewisan mafic and felsic gneisses, but new Pb isotopic analyses show little or no depletion in lithologies with high solidus temperatures, such as peridotite. This suggests that LIL transport in this terrane took place by removal of partial melts rather than by pervasive flooding with externally derived CO2. The Pb and Nd isotopic data gathered on these rocks show that the depletion and granulite metamorphism are distinct events about 250 Ma apart. Both fluid inclusions and cation exchange geothermometers date from the later metamorphic event and therefore have little bearing on the depletion event, suggesting a note of caution for interpretations of other granulite terranes.

9661 (N—88-30201, pp 49-50) **Genesis of archean granitoids in the Pilbara block and implications for crustal growth.** Collins, W.J. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The origin of the Mount Edgar Batholith of the Pilbara Block in Western Australia is discussed, along with other Archean

granitoids that show relatively primitive isotopic characteristics but more evolved bulk geochemistry. Geochemical evidence is presented in support of a multistage process of crustal ripening, involving partial melting of a thick basaltic crust to produce the tonalitic and dacitic sources of the more evolved granitoids. These events must produce stable continental crust in less than 200 Ma and are different geologically and geochemically from those which produced Phanerozoic granitoids in Andean margin settings.

9662 (N—88-30201, pp 51-54) **Role of zircon in tracing crustal growth and recycling.** Compston, W.; Williams, I.S.; Armstrong, R.A.; Claoue-Long, J.C.; Kinny, P.D.; Foster, J.J.; Kroener, A.; Pidgeon, R.T.; Myers, J.S. (Western Australian Inst. of Tech., Bentley). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Single crystal ion probe ages of zircons is discussed, which allow much better time resolution compared to other geochronological methods, although the technique is not without problems. Rocks from two areas that contain composite zircon populations, including true magmatic zircons as well as a variety of xenocrystic types are described. It is often difficult to distinguish these; xenocrystic zircons, for example, cannot always be identified on the basis of morphology alone. Additional evidence is needed before making age interpretations. Evidence is also presented of zircon growth long after the original time of crystallization, in some cases apparently at temperatures less than 300 C. The spectacular discovery of 4.1 to 4.2 Ga detrital zircons in metaquartzites from the Mount Narryer area of Western Australia is described. Similar zircons with ages as old as 4276 Ma have been found in the nearby Jack Hills area. The source areas or parent lithologies of these zircons have not yet been determined, but the author expects that they may be unrecognized or buried antecedents of the K rich Narryer gneisses. U or Th concentrations of zircon cannot be used to discriminate between felsic and mafic source rocks.

9663 (N—88-30201, pp 54-56) **Chronology of early lunar crust.** Dasch, E.J.; Nyquist, L.E.; Ryder, G. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The chronology of lunar rocks is summarized. The oldest pristine (i.e., lacking meteoritic contamination of admixed components) lunar rock, recently dated with Sm-Nd by Lugmair, is a ferroan anorthosite, with an age of 4.44 + 0.02 Ga. Ages of Mg-suite rocks (4.1 to 4.5 Ga) have large uncertainties, so that age differences between lunar plutonic rock suites cannot yet be resolved. Most mare basalts crystallized between 3.1 and 3.9 Ga. The vast bulk of the lunar crust, therefore, formed before the oldest preserved terrestrial rocks. If the Moon accreted at 4.56 Ga, then 120 Ma may have elapsed before lunar crust was formed.

9664 (N—88-30201, pp 57-58) **Construction of mass-age curves for the continental crust: an empirical model and an example from the western US.** Depaolo, D.J.; Schubert, G.S.; Linn, A. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The methodology of determining crustal mass-age curves is discussed. Problems in doing this include determination of model ages and accounting for mixing of materials of different ages during crust forming processes. These difficulties can be overcome with some reasonable assumptions and estimates of rock volumes based on areal proportions. This technique was used to construct a reasonably well constrained mass-age curve for the southwestern U.S. based on isotopic measurements on over 100 samples. The results imply that the crust in this area grew episodically at 2.8, 1.8, and 0.1 Ga. It is estimated that it would take on the order of 10000 to 100000 individual Sm-Nd isotopic measurements to carry out a similar exercise for continental crust world wide.

9665 (N—88-30201, pp 59-61) **Does subduction zone magmatism produce average continental crust.** Ellam, R.M.; Hawkesworth, C.J. (Open Univ., Milton (England)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The question of whether present day subduction zone magmatism produces material of average continental crust composition, which perhaps most would agree is andesitic, is addressed. It was argued that modern andesitic to dacitic rocks in Andean-type settings are produced by plagioclase fractionation of mantle derived basalts, leaving a complementary residue with low Rb/Sr and a positive Eu anomaly. This residue must be removed, for example by delamination, if the average crust produced in these settings is andesitic. The author argued against this, pointing out the absence of evidence for such a signature in the mantle. Either the average crust is not andesitic, a conclusion the author was not entirely comfortable with, or other crust forming processes must be sought. One possibility is that during the Archean, direct slab melting of basaltic or eclogitic oceanic crust produced felsic melts, which together with about 65 percent mafic material, yielded an average crust of andesitic composition.

9666 (N—88-30201, pp 62-64) **Pb isotope constaints on the extent of crustal recycling into a steady state mantle.** Galer, S.J.G.; Goldstein, S.L.; Onions, R.K. (Cambridge Univ. (England)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Isotopic and geochemical evidence was discussed against recycling of continental crust into the mantle. Element ratios such as Sm/Nd, Th/Sc, and U/Pb in sedimentary masses have remained relatively constant throughout Earth history, and this can only be reconciled with steady state recycling models if new crustal materials added from the mantle have had similar ratios. Such recycling models would also require shorter processing times for U, Th, and Pb through the mantle than are geodynamically reasonable. Models favoring subduction of pelagic sediments as the only recycling mechanism fail to account for the Pb isotopic signature of the mantle. Recycling of bulk crust with Pb isotopic compositions similar to those expected for primitive mantle would be permissable with available data, but there appear to be no plausible tectonic mechanisms to carry this out.

9667 (N—88-30201, pp 65-67) **Decoupled Rb-Sr and Sm-Nd isotopic evolution of the continental crust.** Goldstein, S.L. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Evidence was presented that the Rb-Sr and Sm-Nd isotopic systems are decoupled in crust-mantle evolution. Rare earth element (including Sm and Nd) residue principally in silicates, and are resistant to mobilization by weathering and metamorphism. In contrast, Rb and Sr are easily fractionated by crustal processes and residue in carbonates as well as in silicates. As a result, continental Sr, but not Nd, can be recycled into the mantle by exchange of seawater with basalt at spreading ridges and by subduction of carbonates associated with ridge processes. These effects result in mean Rb-Sr ages of the continental crust and of the upper mantle that are too young. Crustal growth curves based largely on Rb-Sr data, such that of Hurley and Rand, are therefore incorrect.

9668 (N—88-30201, pp 71-73) **Metamorphic P-T paths and Precambrian crustal growth in East Antarctica.** Harley, S.L. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The metamorphic constraints on crustal thicknesses in Archean and post-Archean terranes are summarized along with possible implications for tectonic processes. It is important to recognize that P-T estimates represent perturbed conditions and should not be

used to estimate steady state geothermal gradients or crustal thicknesses. The example is cited of the Dora Maira complex in the French Alps, where crustal rocks record conditions of 35 kbar and 800 C, implying their subduction to depths of 100 km or more, followed by subsequent uplift to the surface. Therefore such P-T estimates tell more about processes than crustal thicknesses. More importantly, according to the author, are determinations of P-T paths, particularly coupled with age measurements, because these may provide constraints on how and when perturbed conditions relax back to steady state conditions. P-T paths are illustrated that should be expected from specific tectonic processes, including Tibetan style collision, with and without subsequent extension, rifting of thin or thickened crust, and magmatic accretion. Growth of new crust, associated with magmatic accretion, for example, could possibly be monitored with these P-T paths.

**9669** (N—88-30201, pp 74-76) **Early intense cratering: effects on growth of earth's crust.** Hartmann, W.K. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The disrupting effects of early intense meteorite bombardment on Earth's protocrustal evolution is discussed. The author emphasized that one should not consider the Earth's impact history as a discrete phase separate from an early crust forming event, and also that the end of the impacts was not a singular event that destroyed all previously formed crust.

**9670** (N—88-30201, pp 77-78) **Growth of continents and some consequences since 1.5 Ga.** Howell, D.G. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The budget of Earth's oceanic sediment masses was discussed in terms of crustal growth and recycling. Based on estimates of the volume of oceanic sediments and the average age of oceanic crust, a continental denudation rate of 1.65 cu km/yr was computed. This crudely balances estimated crustal production rates of about 1 cu km/yr, but the efficiency of sediment loss via subduction, for example, must be considered. It was argued, on the basis of earthquake focal solutions, imagery of subduction zones, and plate kinematic reconstructions that little, if any, sediment was lost in this way. This yields a present day crustal growth rate of about 1 cu km/yr. The volume of continents to 1.5 Ga ago was discussed, assuming constant continental thickness and freeboard, and a constant hydrosphere volume. It was concluded that ocean ridge length was a factor of about 1.75 greater 1.5 Ga ago, but a major uncertainty is the average spreading rate in the past.

**9671** (N—88-30201, pp 79-81) **Early archaean crustal history of West Greenland as recorded by detrital zircons.** Kinny, P.D.; Compston, W.; Mcgregor, V.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The isotope systematics of some of the oldest samples on Earth from both Greenland and Australia was discussed. The antiquity was confirmed of the 4.1 to 4.2 Ga zircons from Western Australia; the model Lu-Hf age of these zircons, as measured with the ANU ion probe is 4.14 + or - 0.24 Ga, although the oldest preserved rock units there are anorthosites with a Lu-Hf model age of about 3.73 Ga. U-Pb ion probe ages of detrital zircons ranging between 2.87 and 3.89 Ga from an Akilia association quartzite was reported, whose age of deposition is probably around 3.8 Ga. It was argued that the younger age in this range are discordant because of late Pb-loss, probably associated with a high grade metamorphic event at about 3.6 Ga. It was also argued that the earliest crust in West Greenland and elsewhere is about 3.9 Ga, but in some places, such as Western Australia, crustal evolution took place much earlier, perhaps starting as far back as 4.3 Ga. This would account for the presence in that terrane of abundant K rich granitoid, the paucity of tonalitic and trondhjemitic materials, and the existence of Eu anomalies in early Archean sediments.

**9672** (N—88-30201, pp 85-87) **Growth of early archaean crust in the ancient Gneiss complex of Swaziland and adjacent Barberton Greenstone Belt, Southern Africa.** Kroener, A.; Compston, W.; Tegtmeyer, A.; Milisenda, C.; Liew, T.C. (Max-Planck-Inst. fuer Chemie, Mainz (West Germany)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The relationship between early Archean greenstones and high grade gneisses in the Ancient Gneiss Complex of Swaziland and the neighboring Barberton greenstone belt in Southern Africa is discussed. New high precision zircon analyses reveal a complex history in individual zircons from tonalitic orthogneisses, with ages as old as 3644 + 4 Ma. This suggests the presence of continental crust prior to the formation of the supracrustal rocks of the Barberton greenstone belt, which have been previously considered the earliest rocks in the area. The author suggested that these data are incompatible with the intraoceanic settings that have been widely accepted for this terrane, and favors either a marginal basin or rift environment. By using the detailed age information obtained from zircons in combination with Ar-40 and Ar-39 and paleomagnetic measurements, the author estimated that plate velocities for this part of Africa craton were about 10 to 70 mm/yr, during the period 3.4 to 2.5 Ga. This is not incompatible with the idea that Archean plate velocities may have been similiar to those of today.

**9673** (N—88-30201, pp 88-89) **Diapirs of the Mediterranean ridge: the tectonic regime of an incipient accreted terrane.** Mart, Y. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The occurrence of diapirs in the Mediterranean ridge stems mostly from the massive deposition of salt and gypsum in the Mediterranean basin during the late Miocean. The diapiric emplacement of the evaporitic sequence is not obvious, because the mobilization of the salt beds and the initiation of the diapiric upward flow are constrained by the relatively shallow thickness of the Plio-Pleistocene sedimentary overburden and by the low heat flow that prevails in the eastern Mediterranean. The diapirs consist also of early Cretaceous shales as well as other gravitationally metastable strata which are less mobile than salt. Studies of subduction trenches and their surroundings show that shallow ridges occur seaward of the trenches in many places. The collisional motion between the African and the Eurasian plates would further enhance accretion of sediments in the Mediterranean ridge, which would attain subaerial exposure, and eventually would become a mountain range accreted to southern Europe. The numerous diapirs of salt and shales that occur in the ridge would be common features in the future accreted terrane, indicating an intermediate extensional phase in the tectonic history of the development of crustal growth.

**9674** (N—88-30201, pp 90-91) **Tectonic setting of the Seychelles, Mascarene and Amirante Plateaus in the Western Equatorial Indian Ocean.** Mart, Y. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

A system of marine plateaus occurs in the western equatorial Indian Ocean, forming an arcuate series of wide and shallow banks with small islands in places. The oceanic basins that surround the Seychelles - Amirante region are of various ages and reflect a complex seafloor spreading pattern. The structural analysis of the Seychelle - Amirante - Mascarene region reflects the tectonic evolution of the western equatorial Indian Ocean. It is suggested that due to the seafloor spreading during a tectonic stage, the Seychelles continental block drifted southwestwards to collide with the oceanic crust of the Mascarene Basin, forming an elongated folded structure at first, and then a subduction zone. The morphological similarity, the lithological variability and the different origin of the Seychelles Bank, the Mascarene Plateau and the Amirante Arc emphasizes the significant convergent effects of various plate tectonic processes on the development of marine plateaus.

9675 (N—88-30201, pp 92-94) **Evidence for crustal recycling during the Archean: the parental magmas of the stillwater complex.** McCallum, I.S. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The petrology and geochemistry of the Stillwater Complex, an Archean (2.7 Ga) layered mafic intrusion in the Beartooth Mountains of Montana, is discussed. Efforts to reconstruct the compositions of possible parental magmas and thereby place some constraints on the composition and history of their mantle source regions was studied. A high-Mg andesite or boninite magma best matches the crystallization sequences and mineral compositions of Stillwater cumulates, and represents either a primary magma composition or a secondary magma formed, for example, by assimilation of crustal material by a very Mg-rich melt such as komatiite. Isotopic data do not support the extensive amounts of assimilation required by the komatiite parent hypothesis, and it is argued that the Stillwater magma was generated from a mantle source that had been enriched by recycling and homogenization of older crustal material over a large area.

9676 (N—88-30201, pp 95-97) **Changing styles of crustal growth in Southern Africa: constraints from geochemical and Sr-Nd isotope studies in Archaean to Pan African terrains.** McDermott, F.; Hawkesworth, C.J.; Harris, N.B.W. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Nd isotopic data was presented for southern Africa in support of episodic crustal growth. Over 50 percent of the continental crust there had formed before 2.5 Ga, and less than 10 percent was produced after about 1.0 Ga. The data imply a mean crustal age of about 2.4 Ga for southern Africa, and a higher rate of crustal growth than that derived from Australian shale data, particularly during the Proterozoic. Isotopic data from Damara metasediments imply that there is no need to invoke decoupling of the Rb-Sr and Sm-Nd systems in the continental crust.

9677 (N—88-30201, pp 98-100) **Structure of Southwestern Michipicoten Greenstone Belt, Ontario: evidence for Archean accretion.** McGill, G.E.; Shrady, C.H. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The results of detailed mapping of a well exposed (by a large fume kill) Archean Michipicoten greenstone belt of Ontario is discussed. Numerous structural features are described including soft sediment deformation, thrust faults, isoclinal folds, and sill intrusion, which apparently formed prior to the earliest flattening cleavage. It was inferred that all of these events may have taken place before the rocks were completely lithified, and the question was raised as to whether early soft sediment and tectonic deformation were coeval. If so, the overall picture would permit (but not compel) recognition of a convergent oceanic environment such as an accretionary wedge or forearc basin.

9678 (N—88-30201, pp 101-102) **Mid to late proterozoic magmatism within Northeastern North America and its implications for the growth of the continental crust.** McLelland, J.M. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Recent studies of the mangerite-charnockite-alaskite suite exposed in the Adirondack Highlands strongly suggest that these rocks were emplaced under anorogenic, or mildly extensional, conditions. The characteristic signatures of the rocks are high (FeO/FeO+MgO) and (FeO/Fe2O3); mildly alkaline to subalkaline and metaluminous trends; high Ga/Al2O3; and within plate concentrations of Nb vs Y, Ta vs Yb, Rb vs (Y+Nb), and Rb vs (Yb+Ta). Evolved members of the series are low in CaO and MgO and high in alkalies and halogens. All of these properties are consistent with anorogenic magmatism comprising acidic crustal melts and mantle derived mafic additions to the crust. Major and minor element trends, as well as field evidence, strongly suggest that the anorogenic acidic suite is coeval, but not comagmatic, with closely associated anorthositic massifs. Present outcrop configurations are consistent with the evolution of the acidic and anorthositic rocks in zoned, bimodal magma chambers cored by the mafic constituents and overlain by explosive, caldera-type volcanism. Age determinations indicate that the emplacement of the anorthosite-charnockite suite extended over approximately 500 Ma in the Grenville and adjacent Nain, Provinces.

9679 (N—88-30201, pp 103-105) **Thermal models pertaining to continental growth.** Morgan, P.; Ashwal, L. (Univ. of Northern Arizona, Flagstaff (USA)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Thermal models are important to understanding continental growth as the genesis, stabilization, and possible recycling of continental crust are closely related to the tectonic processes of the earth which are driven primarily by heat. The thermal energy budget of the earth was slowly decreasing since core formation, and thus the energy driving the terrestrial tectonic engine was decreasing. This fundamental observation was used to develop a logic tree defining the options for continental growth throughout earth history.

9680 (N—88-30201, pp 106) **Tectonic setting of Archean anorthosites.** Morrison, D.A.; Phinney, W.C.; Maczuga, D.E. (Lockheed Engineering and Management Services Co., Inc., Houston, TX (USA)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Archean anorthosites, anorthositic gabbros, and related rocks form intrusive complexes in every Archean craton. These complexes are characterized by the presence of equidimensional plagioclase megacrysts of typically uniform and calcic (An80-90) composition. Many, if not all, such complexes developed in greenstone belt terrains and appear to be genetically linked to contemporary volcanics. The petrogenesis of Archean anorthosites appears to argue for development in oceanic settings and implies intensive magmatic activity.

9681 (N—88-30201, pp 107-109) **Petrogenesis of oceanic kimberlites and included mantle megacrysts: the Malaitan alnoite.** Neal, C.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The study of unambiguous suboceanic mantle was facilitated by the occurrence of anomalous kimberlite-type intrusives on Malaita in the Solomon Islands. The pseudo-kimberlites were termed alnoites, and are basically mica lamprophyres with melilite in the ground mass. Alnoitic magmas were explosively intruded into the Ontong Java Plateau (OJP) 34 Ma ago. The OJP is a vastly overthickened portion of the Pacific plate which now abuts the Indo-Australian plate. Malaita is considered to be the obducted leading edge of the OJP. Initial diapiric upwelling beneath the OJP produced the proto-alnoite magma. After impingement on the rigid lithosphere, megacrysts fractionation occurred, with augites precipitating first, representing the parental magma. Sea water-altered oceanic crust, which underplated the OJP, was assimilated by the proto-alnoite magma during megacrysts fractionation (AFC).

9682 (N—88-30201, pp 110-111) **Ridge-trench collision in Archean and Post-Archean crustal growth: evidence from southern Chile.** Nelson, E.P.; Forsythe, R.D. (Rutgers - The State Univ., New Brunswick, NJ (USA)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The growth of continental crust at convergent plate margins involves both continuous and episodic processes. Ridge-trench collision is one episodic process that can cause significant magmatic and tectonic effects on convergent plate margins. Because the sites of ridge collision (ridge-trench triple junctions) generally migrate along convergent plate boundaries, the effects of ridge collision will be highly diachronous in Andean-type orogenic belts and may not be adequately recognized in the geologic record. The Chile margin triple junction (CMTJ, 46 deg S), where the actively spreading Chile rise is colliding with the sediment-filled Peru-Chile trench, is geometrically and kinematically the simplest modern example of ridge collision. The south Chile margin illustrates the importance of the ridge-collision tectonic setting in crustal evolution at convergent margins. Similarities between ridge-collision features in southern Chile and features of Archean greenstone belts raise the question of the importance of ridge collision in Archean crustal growth. Archean plate tectonic processes were probably different than today; these differences may have affected the nature and importance of ridge collision during Archean crustal growth. In conclusion, it is suggested that smaller plates, greater ridge length, and/or faster spreading all point to the likelihood that ridge collision played a greater role in crustal growth and development of the greenstone-granite terranes during the Archean. However, the effects of modern ridge collision, and the processes involved, are not well enough known to develop specific models for the Archean ridge collison.

**9683** (N—88-30201, pp 112-115) **Reappraisal of the geology of Kangimut Sammisoq, Ameralik Fjord, Southern West Greenland: crustal structure and interpretation of isotopic data.** Nutman, A.P.; Friend, C.R.L.; McGregor, V.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

In Godthabsfjord, in the North Atlantic Archean Craton, early Archean Amitsoq gneisses are found in association with the mid to late Archean Nuk gneisses. The Amitsoq gneisses contain the Ameralik dykes, now subconcordant strips of amphibolite. The Nuk and Amitsoq gneisses have amphibolite facies polymetamorphic assemblages. To the southeast of Godthabsfjord, there is an extensive region affected by granulite facies metamorphism at 2800 Ma. Early models of crustal evolution for Godthabsfjord and the region to the SE are discussed. Recent detailed mapping combined with U-Pb zircon dating is examined.

**9684** (N—88-30201, pp 116-118) **Archean crustal evolution of the northern North China Craton.** Qian, X.; Chen, Y.; Liu, J. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The Archean granultie facies rocks of the North China (Sino-Korean) Craton mostly occur inside the northern boundary forming a unique and spectacular granulite belt trending roughly E-W from eastern Hebei, North China in the east to Mt. Daqinchan, western Inner Mongolia in the west, ranging about 1,000 km long. Over the years in the middle portion of this Archean high-grade metamorphic belt a stratigraphic unconformity between the khondalite rock assemblage and the medium in composition granulite assemblage in Datong-Xinghe area is determined. The geological structural properties of the North China Craton are discussed.

**9685** (N—88-30201, pp 119-121) **Growth of the lower continental crust.** Rudnick, R.L. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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One of the largest uncertainties in crustal composition and growth models is the nature of the lower continental crust. Specifically, by what processes is it formed and modified, and when is it formed, particularly in reference to the upper crust? The main reason for this lack of information is the scarcity of lower crustal rock samples. These are restricted to two types: rocks which outcrop in granulite facies terrains and granulite facies xenoliths which are transported to the earth's surface by young volcanics. The important conclusions arising from the xenolith studies are: the majority of mafic lower crustal xenoliths formed through cumulate process, resitic xenoliths are rare; and formation and metamorphism of the deep crust is intimately linked to igneous activity and/or orogeny which are manifest in one form or another at the earth's surface. Therefore, estimates of crustal growth based on surface exposures is representative, although the proportion of remobilized pre-existing crust may be significantly greater at the surface than in the deep crust.

**9686** (N—88-30201, pp 122-124) **Complexity, depth, and rapidity of processes that formed the lunar crust.** Ryder, G.; Dasch, J. (Lunar and Planetary Inst., Houston, TX (USA)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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From its birth the moon had a large-scale, complex magma system. The evidence is the massive differentiation of the moon that was partially preserved. The system might be a magma ocean or a magmasphere; even in the former case it was superposed by smaller but also very complex magma systems. The main episode produced a plagioclase-rich crust including genuine anorthosites; it was over by about 4.35 b.y. ago, although magmatism continues. The processes of crust-building remain in serious dispute. Lunar crusts; massive differentiation; crustal material composition; processes which produced crustal materials; and differences from earth are briefly discussed.

**9687** (N—88-30201, pp 125-126) **Continental crustal formation and recycling: evidence from oceanic basalts.** Saunders, A.D.; Tarney, J.; Norry, M.J. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Despite the wealth of geochemical data for subduction-related magma types, and the clear importance of such magmas in the creation of continental crust, there is still no concensus about the relative magnitudes of crustal creation versus crustal destruction (i.e., recycling of crust into the mantle). The role of subducted sediment in the formation of the arc magmas is now well documented; but what proportion of sediment is taken into the deeper mantle? Integrated isotopic and trace element studies of magmas erupted far from presently active subduction zones, in particular basaltic rocks erupted in the ocean basins, are providing important information about the role of crustal recycling. By identifying potential chemical tracers, it is impossible to monitor the effects of crustal recycling, and produce models predicting the mass of material recycled into the mantle throughout long periods of geological time.

**9688** (N—88-30201, pp 127-130) **Geochronological and lead-isotope evidences for rapid crust formation in middle-proterozoic time: the Labrador example.** Schaerer, U. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Extensive U-Pb geochronological studies in the Grenville and Makkovik provinces have shown that eastern Labrador is underlain by two distinct crustal blocks. In order to substantiate the juvenile character of the middle-Proterozoic crustal block, the isotopic compositon of lead in leached k-feldspars from the same rocks were analyzed. The results of the analysis are briefly discussed.

**9689** (N—88-30201, pp 131-132) **Physical processes in the growth of the continental crust.** Schubert, G. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Major mechanisms of crustal addition are volcanism and plutonism at plate boundaries and within plate interiors. One approach to deciding if island arc magmatism dominated ancient crustal growth is to assess the rate at which the process has operated in the

recent past. The localized addition rates were found to be comparable to present day global rates. One physical observable that was used to constrain models of crustal growth is sea level. A simple physical model was developed to explore the consequences of constant freeboard (the height of the continents above sea level). Global geoid and sea floor topography data were used to identify and study oceanic plateaus and swells that have either continental crustal roots or anomalously thick ocean crusts.

9690 (N—88-30201, pp 133-135) **Evolution of the Dharwar Craton: a terrain of early Archean crustal stability, long term orogenic cycles and large scale palaeobiological activity.** Srinivasan, R.; Naqvi, S.M. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Traceable history of the Dharwar Craton goes back to approximately 3400 m.y. old tonalitic to trondhjemitic fundamental gneiss whose REE composition indicates its derivation from a pre-existing basalt which apparently had very short time of crustal residence. The fundamental gneiss is preserved only as rare relicts in the vast gneissic complex of the Indian Peninsula (the Peninsular Gneiss), and as pebbles in the conglomerates of the Archean Dharwar sequence. Study of these relicts, shows evidence of a deformation episode prior to the deposition of the high- and low-grade Dharwar supracrustal sequence. The Dharwar supracrustal sequence is briefly described. Geochemistry of the volcanic and sedimentary rocks of the Dharwar supracrustal belts are examined.

9691 (N—88-30201, pp 136-138) **Lithospheric evolution of the Northern Arabian Shield: chemical and isotopic evidence from basalts, xenoliths and granites.** Stein, M. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The evolution of the upper-mantle and the lower-crust (the conteinental lithosphere), is the area of Israel and Sinai was studied, using the chemical composition and the Nd-Sr isotopic systematics from mantle and crustal nodules, their host basalts, and granites. The magmatism and the metasomatism making the lithosphere are related to uprise of mantle diapirs in the uppermost mantle of the area. These diapirs heated the base of the lithosphere, eroded, and replaced it with new hot material. It caused a domal uplift of the lithosphere (and the crust). The doming resulted in tensional stresses that in turn might develop transport channels for the basalt.

9692 (N—88-30201, pp 139-140) **Trace element differences between Archean, Proterozoic and Phanerozoic crustal components: Implications for crustal growth processes.** Tarney, J.; Wyborn, L.E.A.; Sheraton, J.W.; Wyborn, D. (Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Critical to models for continental crust growth and recycling are the processes through which crustal growth takes place. In particular, it is important to know whether these processes have changed fundamentally with time in response to the earth's thermal evolution, and whether the crustal compositions generated are compatible with crustal remobilization, crustal recycling, or represent primary additions. There are some significant and consistent differences in the major and trace element compositions of crustal components with time which have important implications for crustal growth processes. These will be illustrated with reference to Archean rocks from a number of shield areas, Proterozoic granitoids from Australia and elsewhere, Palaeozoic granitoids from Australia and Scotland, and Mesozoic - recent granitoids from present continental margin belts. Surprisingly some rather simple and consistent patterns energe this technique. There are then significant differences in compositions of granitoid crustal additions throughout geological time, with a particular type of granitoid apparently dominating a particular time period. This implies that the tectonic processes giving rise to granite generation have changed in response to the earth's thermal evolution.

9693 (N—88-30201, pp 141-143) **Continental growth through time by underplating of subducted oceanic crust: evidence from kimberlites in South Africa and SW Pacific.** Taylor, L.A.; Neal, C.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

In the dynamic model of plate tectonics, it is evident that crustal components are returned to the mantle by subduction. Chemical signatures of these subducted components were identified in ocean island volcanics and in island arc volcanics. Indeed, an origin involving a subducted protolith was postulated for certain types of xenoliths in kimberlite, including diamonds. Recent studies of eclogite xenoliths in kimberlite from southern Africa and megacrysts form the Malaitan alnoite, Solomon islands, indicate that lithospheric underplating by subducted oceanic crust has occurred in these two contrasting areas. The results of new eclogite studies from the Bellsbank kimberlite, South Africa, and isotopic data from the Malaitan alnoite megacryst suite. This forms the basis for discerning the role of lithospheric underplating in the growth of cratons and in the evolution of mantle-derived magma.

9694 (N—88-30201, pp 144-146) **Growth of the continental crust: constraints from radiogenic isotope geochemistry.** Taylor, P.N. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Most models for evolution of continental crust are expressed in the form of a diagram illustrating the cumulative crustal mass (normalized relative to the present crustal mass) as a function of time. Thus, geochronological data inevitably play a major role in either constructing or testing crustal growth models. For all models, determining the start-time for effective crustal accretion is of vital importance. To this end, the continuing search for, and reliable characterization of, the most ancient crustal rock-units remains a worthy enterprise. Another important role for geochronology and radiogenic isotope geochemistry is to assess the status of major geological events as period either of new crust generation or of reworking of earlier formed continental crust. For age characterization of major geological provinces, using the critieria outined, the mass (or volume) of crust surviving to the present day should be determinable as a function of crust formation age. More recent developments, however, appear to set severe limitations on recycling of crust, at least by the process of sediment subduction. In modeling crustal growth without recycling, valuable constaints on growth rate variations through time can be provided if variations in the average age of the continental crust can be monitored through geological history. The question of the average age of the exposed continental crust was addressed by determining Sm-Nd crustal residence model ages (T-CR) for fine-grained sediment loads of many of the world's major rivers.

9695 (N—88-30201, pp 147-149) **Crustal growth in the Archean: the geochemical evidence.** Taylor, S.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Differences between Archean and post-Archean crusts; growth models; Archean high-grade terrains; tectonic significance; and Archean crustal growth are examined briefly.

9696 (N—88-30201, pp 150-152) **Growth of planetary crusts.** Taylor, S.R. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The solid planets and satellites mostly have crusts which differ markedly in composition both from their interior, and from

primordial solar nebula composition. Primary crusts, mercury, icy crusts, early intense cratering, Mars, Venus, Ganymede, and tertiary crusts are discussed.

9697 (N—88-30201, pp 153-155) **Gravity anomalies, plate tectonics and the lateral growth of Precambrian North America.** Thomas, M.D.; Grieve, R.A.F.; Sharpton, V.L. (Geological Survey of Canada, Ottawa, Ontario). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The widespread gravity coverage of North America provides a picture of the gross structural fabric of the continent via the trends of gravity anomalies. The structural picture so obtained reveals a mosaic of gravity trend domains, many of which correlate closely with structural provinces and orogenic terranes. The gravity trend map, interpreted in the light of plate-tectonic theory, thus provides a new perspective for examining the mode of assembly and growth of North America. Suture zones, palaeosubduction directions, and perhaps, contrasting tectonic histories may be identified using gravity patterns.

9698 (N—88-30201, pp 156) **Solid earth as a recycling systems and the lateral growth of Precambrian North America.** Veizer, J. (Geological Survey of Canada, Ottawa, Ontario). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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If plotted on mass vs time diagrams, geologic entities (for example, continental and oceanic crust, sediments, and mineral resources) display an exponential (power law) relationship, with entity per unit time increasing toward the present. This relationship is consistent with the concept of recycling and can be simulated mathematically. The approach is based on the plate tectonic theory and considers area-age or mass-age distributions of crystalline basement and sediments for major global tectonic realms. Each tectonic realm is characterized by a specific lifespan, which is an inverse function of its recycling rate. The estimated average half-area of half-mass ages are given. The corresponding parameters for continental crust are 690 Ma for K/Ar, and approximately 1200 Ma for Rb/Sr and U-Th/Pb dating pairs. Tectonic diversity preserved in the geologic record is therefore a function of time, with oceanic tectonic realms, because of their rapid recycling, underrepresented in the rocks older than approximately 300 Ma. The Sm/Nd isotopic systematic of sediments suggest that, for a near steady-state post-Archean sedimentary mass, recycling is approximately 90 + or - 5 percent cannibalistic. This yields an estimated upper limit on crust-mantle exchange via sediment subduction of approximately 1.1 + or - 0.5 x 10 g a(sup -1) considerably less than demanded by isotopic constraints. The discrepancy may indicate the existence of additional loci, such as orogenic belts, for significant crust-mantle interaction.

9699 (N—88-30201, pp 157-158) **Mineralization through geologic time: evolution of continental crust.** Veizer, J.; Laznicka, P.; Jansen, S.L. (Carleton Univ., Ottawa, Ontario (Canada)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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In analogy to living systems, geologic entities (e.g., rocks, mineral deposits, tectonic realms and domains) are involved in the process of perpetual generation and destruction (birth/death cycles). This results in time distribution patterns akin to age structures in living populations and the systematics is amenable to treatment by the concepts of population dynamics. Utilizing this theoretical approach, the survivorship patterns for major realms of the plate tectonic system, for consitutent rocks, and for the entombed mineral resources are predicted. The present inventory encompasses global economic accumulations of metals by geologic age. The deposits of these metals were assigned to nine broad genetic categories, with an attempt to relate each category to tectonic setting within the framework of global plate tectonics.

9700 (N—88-30201, pp 159-161) **Growth of the continental crust: a planetary-mantle perspective.** Warren, P.H. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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The lack of earth rocks older than about 3.8 Ga is frequently interpreted as evidence that the earth formed little or no subduction-resistant continental crust during the first 700 My of its history. Such models obviously imply that the pre-3.8 Ga earth was covered entirely or almost entirely by smoothly subducting oceanic crust. On the other hand, the thermal regime of the early earth probably tended to cause the oceanic crust at this time to be comparatively thin and comparatively mafic. The present earth is covered by about 50 percent oceanic crust, averaging about 7 km in thickness, and 41 percent continental crust, averaging roughly 40 km in thickness. Thus continentless-early-earth models would seem to imply a total mass of crust less than 1/3 that of the present day earth. Possible explanations are examined.

9701 (N—88-30201, pp 162-164) **Crustal underplating in the North American Craton: evidence from the Petrogenesis of anorthositic rocks in the Middle Proterozoic Midcontinent Rift System.** Weiblen, P.W.; Miller, J.D. Jr. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

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Circumstantial evidence for underplating as a significant mechanism for the growth of continental crust continues to accumulate, particularly from considerations of thermal, seismic, and density contraints on the lower crust and upper mantle. Compelling geochemical and petrological arguments were made that in continental flood basalt provinces, the volume of underplated cumulates may be at least as large as the expression of surface lavas. Geological, petrological, and geochemical data are presented on anorthositic rocks in the Duluth Complex, which indicates that underplating processes similar to those postulated by Cox played a significant role in their origin. The interpretations may be applicable to the origin of anorthositic rocks in general.

9702 (N—88-30201, pp 165-167) **Late-Archaean crustal growth in the Lewisian Complex of Northwest Scotland: diachroneity in magmatic accretion and implications for models of crustal growth.** Whitehouse, M.J. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

The Lewisian Complex of northwestern Scotland is an Archaean basement terrain that was reworked during the Proterozoic. Previous geochronological studies have established that the complex represents an entirely new crustal addition during late-Archaean times, and the difference between a Sm-Nd accretion date of 2920 + or - 50 Ma and a Pb/Pb metamorphic date of 2680 + or - 70 Ma was interpreted as indicating a crustal accretion-differentiation superevent (CADS) lasting 240 + or - 110 Ma. A combined Rb-Sr, Pb/Pb, and Sm-Nd isotopic study reported was applied to the Lewisian CADS to attempt to address the problem of whether this comprised a short regional scale magmatic accretion event followed approximately 200 Ma later by regional high-grade metamorphism, or a long period of episodic or semi-continuous magmatic accretion prior to high-grade metamorphism.

9703 (N—88-30201, pp 168) **Effect of thicker oceanic crust in the Archaean on the growth of continental crust through time.** Wilks, M.E. 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Present crustal evolution models fail to account for the generation of the large volume of continental crust in the required time intervals. All Archaean plate tectonic models, whether invoking faster spreading rates, similar to today's spreading rates, or longer ridge lengths, essentially propose that continental crust has grown

by island arc accretion due to the subduction of oceanic crust. The petrological differences that characterize the Archaean from later terrains result from the subduction of hotter oceanic crust into a hotter mantle. If the oceanic crust was appreciably thicker in the Archaean, as geothermal models would indicate, this thicker crust is surely going to have an effect on tectonic processes. A more valid approach is to compare the possible styles of convergence of thick oceanic crust with modern convergence zones. The best modern analog occurs where thick continental crust is colliding with thick continental crust. Oceanic crustal collision on the scale of the present-day Himalayan continental collision zone may have been a frequent occurrence in the Archaean, resulting in extensive partial melting of the hydrous underthrust oceanic crust to produce voluminous tonalite melts, leaving a depleted stabilized basic residuum. Present-day island arc accretion may not have been the dominant mechanism for the growth of the early Archaean crust.

9704 (N—88-30201, pp 169-171) **Volcanic contribution to crustal growth in the Central Andes: a new estimate and a discussion of uncertainties.** Wood, C.A.; Francis, P. (Lunar and Planetary Inst., Houston, TX (USA)). 1988. NTIS, PC A08/MF A01. (NASA-CR—183073; NAS—1.26:183073; LPI-TR—88-02; CONF-8707204—).

From Workshop on the growth of continental crust; Oxford, UK (13 Jul 1987).

Volcanism above subduction zones is a major mechanism for crustal growth and compared to some other proposed processes calculation of growth rates is relatively easy given accurate volumes and ages of volcanic material. Francis and Rundie (1976) first used this approach in a small region of the Central Andes, and extrapolated their result to the entire Central Andean arc. The derived rate of 3 to 4.2 x 10 to the minus 6th cubic km yr/km of arc length is compared with an independent estimate based upon a reconnaissance census of all major volcanoes in the Central Andes.

9705 **(N—88-30536) Workshop on the Origins of Solar Systems.** Nuth, J.A.; Sylvester, P. (Lunar and Planetary Inst., Houston, TX (USA)). 1988. 107p. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—). NTIS, PC A06/MF A01.

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

Topics addressed include: interstellar chemistry and primitive bodies; astronomical measurements and nebula models; solar nebula models and meteorite; and planetary accumulation and evolution.

9706 (N—88-30536, pp 5-21) **Star formation and molecular clouds.** Tielens, A.G.G.M. 1988. NTIS, PC A06/MF A01. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—).

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

Several differnt stages can be discerned within the star formation process. Star formation can be considered to start when a molecular cloud fragments into many clumps. Many different physical processes are likely to play an important role in star formation, including self-gravity, magnetic fields, rotation, winds, and radiation transport. The current knowledge on some of these processes are reviewed.

9707 (N—88-30536, pp 23-29) **Observations of star formation.** Welch, W.J. 1988. NTIS, PC A06/MF A01. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—).

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

The present observational status of objects that have some bearing on star formation are reviewed: giant molecular clouds, cloud cores and T-Tauri stars, outflows, infall, disks, and interstellar chemistry. Prospects for the future are summarized.

9708 (N—88-30536, pp 31-37) **Comparisons of solar nebula models.** Weidenschilling, S.J. 1988. NTIS, PC A06/MF A01. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—).

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

The relationship between meteorites and solar nebulae is examined. Turbulent models of the solar nebulae are compared and discussed.

9709 (N—88-30536, pp 45-49) **Nebular processes recorded in chondritic meteorites.** Wasson, J.T. 1988. NTIS, PC A06/MF A01. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—).

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

The key fact concerning the chondritic meteorites is that they consist of grains that were present in the solar nebulae. The most primitive (least altered) of them have preserved in their chemical compositions and in their structures evidence concerning processes that occurred in the nebulae 4.5 Ga ago. The chondrites that were not metamorphosed, however, preserve much information about the earliest history of the nebula and are worthy of intense, long-term study. By studying them we can attempt to infer the times and places at which the various chondrite group formed and the conditions present at each of these places.

9710 (N—88-30536, pp 51-59) **Cosmochemical trends of volatile elements in the solar system.** Fegley, B. Jr. 1988. NTIS, PC A06/MF A01. (NASA-CR—183025; NAS—1.26:183025; LPI-TR—88-04; CONF-8612169—).

From Workshop on the origins of solar systems; Queenstown, MD, USA (15 Dec 1986).

Chemical interactions between gases and grains in the solar nebula played a central role in establishing the presently observed volatile element inventories of the planets, their satellites, and the other bodies in the solar system. Kinetic constraints relevant to gas-grain chemical interactions in the solar nebula are reviewed. The abundant, chemically active volatiles H, O, C, N, and S are emphasized; however, less abundant volatiles such as P, Cl, and F are discussed where appropriate.

9711 **(N—88-30545) Far infrared supplement: Catalog of infrared observations, second edition.** Gezari, D.Y.; Schmitz, M.; Mead, J.M. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1988. 233p. (NASA-RP—1205; REPT—88B-121; NAS—1.61:1205). NTIS, PC A11/MF A01.

The Far Infrared Supplement: Catalog of Infrared Observations summarizes all infrared astronomical observations at far infrared wavelengths (5 to 1000 microns) published in the scientific literature from 1965 through 1986. The Supplement list contain 25 percent of the observations in the full Catalog of Infrared Observations (CIO), and essentially eliminates most visible stars from the listings. The Supplement is thus more compact than the main catalog, and is intended for easy reference during astronomical observations. The Far Infrared Supplement (2nd Edition) includes the Index of Infrared Source Positions and the Bibliography of Infrared Astronomy for the subset of far infrared observations listed.

9712 **(N—88-30547) Guide star catalog.** Lasker, B.M.; Jenkner, H.; Russell, J.L. (Space Telescope Science Inst., Baltimore, MD (USA)). Jul 1987. 15p. (NASA-CR—183253; NAS—1.26:183253; PPS—187). NTIS, PC A03/MF A01.

Part 1 of the catalog presents an astronomical overview of the Guide Star Catalog, together with its history, the properties of its current implementation, and the prospects for enhancement. Part 2 presents the algorithms used in photometric and astrometric calibration of the catalog, as well as the analyses of the related errors. Part 3 presents the current structure and content, as well as future enhancements in this area. An overview of the forthcoming publications is given, both with regard to scientific papers and electronic media.

9713 **(N—88-30549) Starbursts and their dynamics.** Norman, C. (Space Telescope Science Inst., Baltimore, MD (USA)). Aug 1987. 10p. (NASA-CR—180227; NAS—1.26:180227; PPS—190). NTIS, PC A02/MF A01.

Detailed mechanisms associated with dynamical process occurring in starburst galaxies are considered including the role of bars, waves, mergers, sinking satellites, self gravitating gas and bulge heating. The current understanding of starburst galaxies both observational and theoretical is placed in the context of theories of galaxy formations, Hubble sequence evolution, starbursts and activity, and the nature of quasar absorption lines.

9714 **(N—88-30550) Evolutionary helium and CNO anomalies in the atmospheres and winds of massive hot stars.** Walborn, N.R. (Space Telescope Science Inst., Baltimore, MD (USA)). Sep 1987. 13p. (NASA-CR—183254; NAS—1.26:183254; PPS—202). NTIS, PC A03/MF A01.

The ubiquitous evidence for processed materials in the atmospheres, winds, and circumstellar ejecta of massive stars is reviewed. A broad array of normal and peculiar evolutionary stages is considered, up to and including Type II supernova progenitors. The quantitative analysis of these spectra is difficult, and until recently for the most part only qualitative or approximate results have been available. However, several important current programs promise reliable abundance calculations. A significant emerging result is that the morphologically normal majority of both hot and cold supergiants may already display an admixture of CNO-cycle products in their atmospheres. It may become possible in this way to identify blue supergiants returning from the red supergiant region, as appears to have been the case for the SN 1987A progenitor.

9715 **(N—88-30555) Observations of faint field galaxies.** Koo, D.C. (Space Telescope Science Inst., Baltimore, MD (USA)). Sep 1987. 9p. (NASA-CR—183251; NAS—1.26:183251; PPS—205). NTIS, PC A02/MF A01.

Number counts, colors, and angular correlations of field galaxies fainter than 20th mag are summarized. Resulting conclusions regarding the presence and nature of luminosity, spectral, and clustering evolution remain contraversial. Preliminary analysis of two major spectroscopic surveys near completion suggests that by z approximately 0.5, larger numbers of very blue galaxies of moderate luminosities are found than today. The skewer-like surveys also provide new probes of galaxy clustering on scales previously unexplored (larger than 200 Mpc) and over lookback times of several billion years.

9716 **(N—88-30558) Deep redshift survey of field galaxies. Comments on the reality of the Butcher-Oemler effect.** Koo, D.C.; Kron, R.G. (Space Telescope Science Inst., Baltimore, MD (USA)). Sep 1987. 16p. (NASA-CR—183255; NAS—1.26:183255; PPS—204). NTIS, PC A03/MF A01.

A spectroscopic survey of over 400 field galaxies has been completed in three fields for which we have deep UBVI photographic photometry. The galaxies typically range from B=20 to 22 and possess redshifts z from 0.1 to 0.5 that are often quite spiky in distribution. Little, if any, luminosity evolution is observed up to redshifts z approx 0.5. By such redshifts, however, an unexpectedly large fraction of luminous galaxies has very blue intrinsic colors that suggest extensive star formation; in contrast, the reddest galaxies still have colors that match those of present-day ellipticals.

9717 **(N—88-30572) Extended atmospheres of outer planet satellites and comets. Final report, 1 August 1984-31 August 1988.** Smyth, W.H.; Combi, M.R. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). Aug 1988. 28p. (NASA-CR—183157; NAS—1.26:183157). NTIS, PC A03/MF A01.

In the third year of this 3-year project, research accomplishments are discussed and related to the overall objective. In the area of the distribution of hydrogen in the Saturn system, new Voyager UVS data have been discovered and are discussed. The data suggest that both Titan's hydrogen torus and Saturn's hydrogen corona play a major role in the circumplanetary gas source. Modeling analysis of this new data establishes a strong basis for continuing studies to be undertaken in a new NASA-sponsored project. In the area of the cometary atmospheres, observational data for H, O, C, and OH acquired with the Pioneer Venus Orbiter are evaluated and preliminary modeling analysis for some of the hydrogen Lyman-alpha data is presented. In addition, the importance of collisional thermalization in spatial properties and structure of the inner and extended comae of comets has been demonstrated using the recently developed particle trajectory model. The successful simulation by this model of the hydrogen Lyman-alpha image for Comet Kohoutec near perihelion, an extreme case for collisional thermalization, is particularly noteworthy.

9718 **(N—89-10419) Wilson cycle studies. Semiannual report, 14 January-15 July 1988.** Burke, K. (Houston Univ., TX (USA)). Jul 1988. 19p. (NASA-CR—183146; NAS—1.26:183146). NTIS, PC A03/MF A01.

Effort was concentrated in problems of continental evolution and a presentation was made to a workshop on the Deep Continental Growth of South India. An interpretation of the lithospheric structure of Africa as related to continental collision (together with its volcanism and topography) was prepared and a paper on this topic is about to be submitted. No expenditures were charged to the grant during this 6 month period.

9719 **(N—89-10772) Interplanetary medium data book. Supplement 3: 1977-1985.** Couzens, D.A.; King, J.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1986. 246p. (NASA-TM—101205; NSSDC/WDC-A-R/S—86-04-SUPPL-3; NAS—1.15:101205). NTIS, PC A11/MF A01.

The updating of the hourly resolution, near-Earth solar wind data compilation is discussed. Data plots and listings are then presented. In the text, the time shifting of ISEE 3 fine-scale magnetic field and and plasma data, using corotation delay, and the normalization of IMP-MIT and ISEE densities and temperatures to equivalent IMP-LANL values, are discussed in detail. The levels of arbitrariness in combining data sets, and of random differences between data sets, are elucidated.

9720 **(N—89-10774) Summary of major activities of the UNH and NRL groups. Annual progress report, 15 November 1987-14 May 1988.** Chupp, E.L. (New Hampshire Univ., Durham (USA)). Aug 1988. 22p. (NASA-CR—180949; NAS—1.26:180949). NTIS, PC A03/MF A01.

The major activities of the SMM GRS team members at the University of New Hampshire and the Naval Research Laboratory since the last semi-annual report are summarized. An updated list of published papers and invited papers or contributed papers presented at scientific meetings is provided.

9721 **(N—89-10779) Dynamics of the Venus ionosphere. Final technical report, 1 January 1985-31 May 1988.** Miller, K.L. (Utah State Univ., Logan (USA)). 1988. 31p. (NASA-CR—183167; NAS—1.26:183167). NTIS, PC A03/MF A01.

Data from the Pioneer-Venus orbiter has demonstrated the importance of understanding ion dynamics in the Venus ionosphere. The analysis of the data has shown that during solar maximum the topside Venus ionosphere in the dark hemisphere is generated almost entirely on the dayside of the planet during solar maximum, and flows with supersonic velocities across the terminator into the nightside. The flow field in the ionosphere is mainly axially-symmetric about the sun-Venus axis, as are most measured ionospheric quantities. The primary data base used consisted of the ion velocity measurements made by the RPA during three years that periapsis of the orbiter was maintained in the Venus ionosphere. Examples of ion velocities were published and modeled. This research examined the planetary flow patterns measured in the Venus ionosphere, and the physical implications of departures from the mean flow.

9722 **(N—89-10827) C 4 fluxes from the sun as a star and the correlation with magnetic flux. Final report.** Schrijver, C.J.; Linsky, J.L.; Bennett, J.; Brown, A.; Saar, S.H. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). Aug 1988. 13p. (NASA-CR—183156; NAS—1.26:183156; UCB—153-1213). NTIS, PC A03/MF A01.

A total of 144 C 4 wavelength 1548 SMM-UVSP spectroheliograms of solar plages were analyzed, some of which are series of exposures of the same region on the same day. Also analyzed were C 4 wavelength 1551 rasters of plages and C 4 1548 rasters of the quiet sun. The sample contains data on 17 different plages, observed

on 50 different days. The center-to-limb variations of the active regions show that the optical thickness effects in the C 4 wavelength 1548 line can be neglected in the conversion from intensity to flux density. As expected for the nearly optically thin situation, the C 4 1548 line is twice as bright as the C 4 wavelength 1551 line. The average C 4 wavelength 1548 flux density for a quiet is 2700 erg/cm/s and, with surprisingly little scatter, 18,000 erg/cm/s for plages. The intensity histograms of rasters obtained at disk centers can be separated into characteristic plage and quiet-sun contributions with variable relative filling factors. The disk-averaged flux density in the C 4 doublet and the disk-averaged magnitude of the magnetic flux density are related. The relationship between the C 4 and magnetic flux densities for spatially resolved data is inferred to be almost the same, with only an additional factor of order unity in the constant of proportionality.

9723 **(N—89-11657) O stars and Wolf-Rayet stars.** Conti, P.S.; Underhill, A.B.; Jordan, S.; Thomas, R. (National Aeronautics and Space Administration, Washington, DC (USA)). 1988. 508p. (NASA-SP—497; NAS—1.21:497). SOD HC $24.00 as 033-000-01021-4; NTIS A01.

Basic information is given about O and Wolf-Rayet stars indicating how these stars are defined and what their chief observable properties are. Part 2 of the volume discussed four related themes pertaining to the hottest and most luminous stars. Presented are: an observational overview of the spectroscopic classification and extrinsic properties of O and Wolf-Rayet stars; the intrinsic parameters of luminosity, effective temperature, mass, and composition of the stars, and a discussion of their viability; stellar wind properties; and the related issues concerning the efforts of stellar radiation and wind on the immediate interstellar environment are presented.

9724 **(N—89-11673) Relative supernova rates and nucleosynthesis roles.** Arnett, W.D.; Schramm, D.N.; Truran, J.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1988. 10p. (NASA-CR—183373; NAS—1.26:183373; FERMILAB-PUB—88/118-A). NTIS, PC A02/MF A01.

It is shown that the Ni-56-Fe-56 observed in SN 1987A argues that core collapse supernovae may be responsible for more that 50 percent of the iron in the galaxy. Furthermore it is argued that the time averaged rate of thermonuclear driven Type I supernovae may be at least an order of magnitude lower than the average rate of core collapse supernovae. The present low rate of Type II supernovae (below their time averaged rate of approx. 1/10 yr) is either because the past rate was much higher because many core collapse supernovae are dim like SN 1987A. However, even in this latter case they are only an order of magnitude dimmer that normal Type II's due to the contribution of Ni-56 decay to the light curve.

9725 **(N—89-11675) Photoerosion and the abundances of the light elements.** Boyd, R.N.; Ferland, G.J.; Schramm, D.N. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1988. 15p. (NASA-CR—183372; NAS—1.26:183372; FERMILAB-PUB—88/132-A). NTIS, PC A03/MF A01.

The abundances of the rare light elements H-2, He-3, Li-7, and B-11 are shown to be potentially affected by photoerosion. That process, involving the interaction of high energy photons from galactic centers with atomic nuclei, will increase the abundances of H-2, He-3, and B-11 while lowering slightly those of Li-7 and He-4. In some regions of galaxies the effects may be large enough to impact their chemical evolution. In particular this process may have enhanced the H-2 and He-3 abundances near the center of our galaxy over and above those from the big bang, as well as the galactic B-11 abundance over that from cosmic-ray spallation.

9726 **(N—89-11678) Wave-particle interactions in the magnetosphere of Uranus.** Kurth, W.S.; Gurnett, D.A.; Scarf, F.L.; Coroniti, F.V. (Iowa Univ., Iowa City (USA)). Jul 1988. 75p. (NASA-CR—183299; NAS—1.26:183299; UI—88-13). NTIS, PC A04/MF A01.

The Voyager 2 encounter of Uranus has provided observations of plasma waves in and near the magnetosphere. These data, while the first from Uranus, will also be the only direct information on wave-particle interactions at this planet for many years to come. The observations include electrostatic waves upstream of the bow shock, turbulence in the shock, Bernstein emissions and whistler mode waves in the magnetosphere, broadband electrostatic noise in the magnetotail, and a number of the other types of plasma waves which have yet to be clearly identified. Each of these types of waves exist in a plasma environment which both supports the growth of the waves and is modified by interactions with the waves. Wave-particle interactions provide the channels through which the waves can accelerate, scatter, or thermalize the plasmas. The most spectacular example in the case of Uranus is the extremely intense whistler mode activity in the inner magnetosphere which is the source of strong pitch angle diffusion. The resulting electron precipitation is sufficient to produce the auroral emissions observed by Voyager. The strong diffusion, however, presents the problem of supplying electrons in the range of 5 to 40 keV in order to support the losses to the atmosphere.

9727 **(N—89-11686) Sky study of fast X-ray transients. Ph.D. Thesis.** Connors, A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1988. 322p. (NASA-TM—89716; REPT—88-014; NAS—1.15:89716). NTIS, PC A14/MF A01.

In the HEAO 1 A-2 survey of fast X-ray transients, a search of 2 to 20 keV scanning data was made for brief increases in flux, greater than 4 millicrabs, on timescales approximately 1 to 10 to the 4th s above a 12-hour average. The search was divided into two regions, and all-sky survey of the Galaxy, and a survey of the Magellanic Clouds. In the latter, 37 events were found and identified with 4 of the 5 brighest sources in the LMC, plus 2 as flares from a foreground star. Np X-ray bursts, no gamma-ray bursts, and no events from the SMC were found. In the all-sky survey, after excluding well-known variable sources, out of the equivalent of approximately 104 days of data, 15 events were found which falling into 2 broad categories: flares from coronal sources, roughly isotropically distributed, with optically thin thermal spectra; and harder fast transients apparently distributed near the Galactic plane. The first were identified as flares from ubiquitous active cool dwarf stars. It was hypothesized that the second may have been from distant Be-neutron star binaries. However, at least two of the harder, more luminous events remained unidentified. Future research should examine the nature of these rare events, and how they may fit into a hierarchy of hard fast transients from gamma-ray bursts to outbursts from pulsar systems.

9728 **(PB—88-249297/XAB) Solar-Geophysical Data Number 527, July 1988. Part 1 (prompt reports). Data for June, May 1988, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jul 1988. 165p. (SGD—527-PT-1). NTIS, PC A08/MF A01.

See also PB—88-217393 and PB—88-249305.

Contents include: detailed index for 1987 and 1988; data for June 1988--(iuwds alert periods (advance and worldwide), solar-activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field); data for may 1988--(solar-active regions, sudden ionospheric disturbances, solar radio-spectral observations, cosmic-ray measurements by neutron monitor, geomagnetic indices, radio-propagation indices); late data--(radio-propagation indices, April 1988, cosmic-ray measurements by neutron monitor).

9729 **(PB—88-249305/XAB) Solar-Geophysical Data Number 527, July 1988. Part 2 (comprehensive reports). Data for January 1988.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jul 1988. 53p. (SGD—527-PT-2). NTIS, PC A04/MF A01.

See also PB—88-249297.

Contents include: detailed index for 1987 and 1988; data for January 1987--(Meudon Carte Synoptique, solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments).

9730 **(PB—88-250717/XAB) Integrated analysis package for Mk-III K-coronameter observations: a user's manual. Technical note.** Archuleta, S.; Beutner, R. (High Altitude Observatory, Boulder, CO (USA)). Jul 1988. 56p. (NCAR/TN—318-IA). NTIS, PC A04/MF A01.

The following document describes the use of the Integrated Analysis Package, IAP, the primary software tool for visual, graphical, and quantitative numerical analysis of solar coronal data acquired with the Mark III Coronameter. IAP was written for use on a VAX 11-780 (haovax, HV) running Berkley Unix version 4.2, but it can easily be ported to other Unix machines. As an accompaniment to the Technical Note, there also exists an IAP Maintenance Manual, providing in house programmers a road map to the code.

9731 **(PB—89-102313/XAB) Molecular radio-line observations of mass loss from red giants.** Olofsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Onsala Space Observatory). 1988. 12p. (REPT—88/29). NTIS, PC E03/MF A01.

The number of molecules detected at radio wavelengths in envelopes around red giants stands presently at 36. Among these, OH and CO have proven to be the most useful for the study of the physical characteristics of a circumstellar envelope. The mass loss rate of the central star can be relatively accurately estimated, and it appears possible to trace its evolution with time. Also, the fascinating objects in transition from the red-giant phase to the planetary nebula phase are becoming observationally accessible.

9732 **(PB—89-104657/XAB) Long-term solar-terrestrial observations. Final report.** (National Research Council, Washington, DC (USA)). 26 Aug 1988. 82p. NTIS, PC A05/MF A01.

Long-Term Solar-Terrestrial Observations report presents the results of an 18-month study of the requirements for long-term monitoring and archiving of solar-terrestrial data. The value of long-term solar-terrestrial observations is discussed together with parameters, associated measurements, and observational problem areas in each of the solar-terrestrial links--the sun, the interplanetary medium, the magnetosphere, and the thermosphere-ionosphere. Some recommendations are offered for coordinated planning for long-term solar-terrestrial observations.

9733 **(PB—89-109904/XAB) Solar-Geophysical Data Number 528, August 1988. Part 1 (prompt reports). Data for July, June 1988, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Aug 1988. 139p. (SGD—528-PT-1). NTIS, PC A07/MF A01.

See also PB—86-213865.

Contents include: data for July 1988; IUWDS alert periods (advance and worldwide); solar-activity indices; solar flares; solar radio emission; solar interferometric chart; Stanford mean solar magnetic field.

9734 **(PB—89-109912/XAB) Solar-Geophysical Data Number 528, August 1988. Part 2 (comprehensive reports). Data for February 1988.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Aug 1988. 41p. (SGD—528-PT-2). NTIS, PC A03/MF A01.

See also PB—89-109904, and PB—86-213873.

Contents include: data for February 1988; Meudon carte synoptique; solar flares; solar radio bursts at fixed frequencies; solar x-ray radiation from GOES satellite; mass ejections from the sun; active prominences and filaments.

9735 **(PB—89-113039/XAB) SELSIS (the Space Environment Laboratory Solar Imaging System): initial requirements. Technical memo.** Hill, V.J.; Speich, D.M. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Space Environment Lab.). Jul 1988. 91p. (NOAA-TM-ERL-SEL—78). NTIS, PC A05/MF A01.

The Space Environment Laboratory Solar Imaging System (SELSIS) Initial Requirements defines the requirements for: routinely acquiring solar images, the image-processing required to provide operational and research quality data, the needs for the image distribution and archival systems, and the image analysis and display capabilities required for operational and research use. SELSIS will provide near real-time solar images to SEL for use by four different user groups: the Space Environment Services Center (SESC) and the USAF Space Forecast Center (SFC) for use in their operational solar forecast centers, the Space Environment Laboratory (SEL) research group, and the National Geophysical Data Center (NGDC) for archival and distribution to other potential users.

9736 **(PB—89-113377/XAB) New picture for the internal rotation of the sun.** Morrow, C.A. (National Center for Atmospheric Research, Boulder, CO (USA)). 1988. 321p. (NCAR/CT—116). NTIS, PC A14/MF A01.

For the last decade, solar-acoustic oscillations have been used to probe the physical properties of the solar interior. The endeavor is called helioseismology and is based on the fact that shifts in the frequency of an oscillation mode, as observed at the surface, contain information about the physical environment in those regions of the interior where the oscillation has energy. The thesis describes a helioseismic quest to determine the angular velocity inside the Sun as a function of depth and latitude. The author has analyzed rotational frequency splittings extracted from 15 days of full-disk observations of the solar-acoustic oscillations (l=15-99) obtained with the Fourier Tachometer (a Doppler analyzing instrument designed by Tim Brown). The observed frequency splittings are compared to those generated by several different physically-motivated models for the solar internal angular velocity.

9737 **(RRK—88-19) Stochastic dynamics of new inflation.** Nakao, Ken-ichi; Nambu, Yasusada; Sasaki, Misao. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jul 1988. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756083/JAW.

We investigate thoroughly the dynamics of an inflation-driving scalar field in terms of an extended version of the stochastic approach proposed by Starobinsky and discuss the spacetime structure of the inflationary universe. To avoid any complications which might arise due to quantum gravity, we concentrate our discussions on the new inflationary universe scenario in which all the energy scales involved are well below the planck mass. The investigation is done both analytically and numerically. In particular, we present a full numerical analysis of the stochastic scalar field dynamics on the phase space. Then implications of the results are discussed.

9738 **(RRK—88-24) Theoretical cosmology and recent observations.** Tomita, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756087/JAW.

The theoretical studies of cosmological models which have been derived since 1970 are briefly reviewed and the recent cosmological observations important for the model selection are discussed.

9739 **Clusters of galaxies from cosmic strings.** Shellard, E.P.S.; Brandenberger, R.H. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3610-3618(15 Dec 1988).

Early discussion of the cosmic-string model of galaxy and cluster formation assumed a one-to-one correspondence between string loops of a given radius and cosmological objects of a given mass. In this paper the self-consistency of this simple picture is investigated and shown to be far from complete. We use Abell clusters as a benchmark to test this assumption, analytically estimating rms fluctuations in the $\Omega = 1$ cold-dark-matter model using random and correlated loop distributions. These results are compared with Monte Carlo simulations which are supplemented with systematic searches for large and rare overdensities. It is found that the majority of Abell clusters are not seeded by individual large loops, but by large mass concentrations of smaller loops. The implications for the cluster correlation function and for cluster morphology are discussed. The breakdown of this one-to-one correspondence is also apparent on galactic scales and mandates a revision of the standard cosmic-string scenario.

9740 **Horizontal branch stars and the neutrino signal from SN 1987A.** Raffelt, G. (Astronomy Department, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3811-3812(15 Dec 1988).

The observed lifetimes of horizontal branch stars yield an upper bound of 3 x 10/sup -50/ cm² for the process $\gamma + {}^4He \rightarrow {}^4He + X^0$ involving some hypothetical boson $X^0$. This result excludes a recent interpretation of the angular distribution of the Irvine-Michigan-Brookhaven and Kamioka signals of the supernova 1987A in terms of the coherent scattering process $X^0 +$ /sup 16/O→/sup 16/O+γ. .AE

9741 **Interstellar electron density fluctuations due to cosmic-ray acceleration at supernova remnant shock waves.** Max, C.E.; Zachary, A.; Arons, J. (Institute of Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **174**: No. 1, 61-65(1 Nov 1988). (CONF-880191—).

From Radio wave scattering in the interstellar medium; San Diego, CA, USA (18 Jan 1988).

We have performed computer simulations to investigate whether sizeable electron density fluctuations might be produced in the process of cosmic-ray acceleration at supernova remnant shock waves. The hypothesis is the following: Cosmic-ray acceleration via a Fermi I mechanism leads to large-amplitude Alfven waves upstream of a supernova remnant shock wave. If the Alfven waves reach a large enough amplitude, they can drive sound waves in the interstellar medium. The fluctuations in the electron density due to these sound waves will then contribute to the observed interstellar scintillation. Our simulations suggest that this mechanism may be a plausible one. Issues remaining to be addressed include the resulting filling factor, and the integrated strength C²/sub n/ to be expected for the turbulence.

9742 **(N—89-10186, pp vp) Gravitational wave searches using the DSN (Deep Space Network).** Nelson, S.J.; Armstrong, J.W. Aug 1988. Translation source information not available . NTIS, PC A14/MF A01.

In Telecommunications and Data Acquisition Report.

The Deep Space Network Doppler spacecraft link is currently the only method available for broadband gravitational wave searches in the 0.01 to 0.001 Hz frequency range. The DSN's role in the worldwide search for gravitational waves is described by first summarizing from the literature current theoretical estimates of gravitational wave strengths and time scales from various astrophysical sources. Current and future detection schemes for ground based and space based detectors are then discussed. Past, present, and future planned or proposed gravitational wave experiments using DSN Doppler tracking are described. Lastly, some major technical challenges to improve gravitational wave sensitivities using the DSN are discussed.

9743 **Inflationary cosmology.** Steinhardt, P.J. (Univ. of Pennsylvania, Philadelphia, PA (US)). pp 567-617 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

The present status of the inflationary universe model is reviewed. The requirements for a particle field theory necessary to implement the model are emphasized.

## 6402 Atmospheric Physics

*REFER ALSO TO CITATION(S) 9728, 9732, 9765*

9744 **(AD-A—197698/4/XAB) High-latitude F-region irregularities: a review and synthesis. Technical report, 1 January 1986-1 July 1987.** Tsunoda, R.T. (SRI International, Menlo Park, CA (USA)). 15 Feb 1988. 144p. NTIS, PC A07/MF A01.

The most-intense, F-region irregularities in the high-latitude ionosphere appear to be produced by convective plasma processes and, in particular, the fluid E x B (gradient drift) interchange instability. Irregularities are produced by convectively mixing plasma across a mean plasma density gradient. The transport of higher-density plasma into regions of lower-density plasma (and vice versa) leads to the development of an irregularity spectrum that extends in scale from about 10 km down to the ion gyroradius. Because irregularities with this range of scales are not independent from larger-scale plasma structures that are produced by other means, the characteristics and processes of > 10-km plasma structure are reviewed and related to those of smaller-scale irregularities. For the large-scale plasma processes, the model includes (1) the formation of 1000-km scale patches in the polar cap from solar-produced plasma that is transported poleward from lower latitudes; (2) the reconfiguration of patches as they convect into the auroral region and become the latitudinally confined but longitudinally extended, plasma-density enhancements near the equatorward auroral boundary; and (3) the production of localized enhancements and depletions along the poleward auroral boundary by soft-particle precipitation and large but localized electric fields.

9745 **(AD-A—197731/3/XAB) Comparison with oblique sounder data of high-latitude HF propagation predictions from RADAR C and AMBCOM computer programs. Professional Paper for October 1987.** Dave, N. (Naval Ocean Systems Center, San Diego, CA (USA)). Jun 1988. 12p. NTIS, PC A03/MF A01.

A study was done using two High Frequency (HF) propagation prediction programs - RADAR C and AMBCOM - to determine how well they predict median values of oblique sounder data of maximum observed frequencies (MOF) at high latitudes. The main differences between RADAR C and AMBCOM are the inclusion in the latter of high-latitude ionosphere and auroral absorption models, as well as a more-sophisticated and accurate ray-tracing scheme. The data used for comparison are taken for the Winnipeg-Resolute Bay path in the year 1959 and for the Andoya-Ft. Monmouth and Andoya-College paths in 1964. The data for the Winnipeg-Resolute Bay corresponds to high sunspot number, while the others correspond to low sunspot number. Hence, the study provides information on the performance of the two programs for various high-latitude paths at both high and low sunspot number. AMBCOM was found to give generally better agreement with the above data than did RADAR C. Comparison of details of model predictions from the two computer programs for the above database is used to form an understanding of this improvement in prediction capability.

9746 **(AD-A—198362/6/XAB) Preliminary study of the dynamics of high-latitude nuclear plumes. Memorandum report.** Fedder, J.A.; Lyon, J.G. (Naval Research Lab., Washington, DC (USA)). 21 Jul 1988. 22p. (NRL-MR—6150). NTIS, PC A03/MF A01.

This memorandum reports the first results of a preliminary study of the late-time behavior of a HANE plasma plume at high-latitude and its interaction with the dynamic plasma processes existing there. The plume is modeled as a region of extremely high ionospheric conductivity. The results demonstrate that the HANE plasma conductivity enhancement polarizes so as to exclude the high-velocity plasma convection and therefore does not take an active part in the energetic high latitude plasma processes.

9747 **(AD-A—198389/9/XAB) Remeasurement of the rate constant and branching ratio for the $N_2i$ + O reaction.** Knutsen, K.; Bierbaum, V.M.; Leone, S.R. (Colorado Univ., Boulder (USA)). 1988. 5p. NTIS, PC A02/MF A01.

Pub. in Planetary and Space Science, Vol. 36, No. 3, 307-310(1988).

Model calculations of atmospheric-ion constituents based on current experimental data predict thermospheric $N_2^+$ densities in excess of measurements taken by the Atmospheric Explorer satellite by up to a factor of two at altitudes between 200 - 400 km (Breig et al., 1983). The major sources of $N_2^+$ in the thermosphere are photoionization, electron-impact ionization, and charge exchange with $O^+(2D)$. A major sink of $N_2^+$ in this region is the reaction: The discrepancy between the currently accepted thermospheric $N_2^+$ model and measured values would be resolved if either this reaction is much faster than has hitherto been reported, or if vibrational

excitation in $N_2^+$ enhances the rate significantly. Selective vibrational enhancement of the (1b) channel leading to $O^+$ has been suggested, since a simple increase in the overall reaction rate would increase the $NO^+$ production and transfer the discrepancy to thermospheric $NO^+$ densities (Abdou et al., 1984). In consideration of this problem, remeasured the rate constant and branching ratio for the ground state $N_2^+ + 0$ reaction was measured at thermal energy.

9748 **(AD-A—198549/8/XAB) Incoherent scatter measurements of the high-latitude ionosphere. Final report, 1 April 1983-1 April 1986.** Vickrey, J.F. (SRI International, Menlo Park, CA (USA)). Jul 1986. 16p. NTIS, PC A03/MF A01.

Tasks summarized include incoherent-scatter radar data taking and analysis, as well as software transfer, theoretical modeling of ionospheric plasma-diffusion processes, and simulation of the proposed CRRES barium releases. Partial Contents include: Scale-Size Dependent Plasma Diffusion Processes; Magnetospheric Generator Properties; Thermal-Ion Upwellings; and Radar Observations of a Pc4 Event.

9749 **(AD-A—198921/9/XAB) Preliminary documentation of the MACH (Mesothermal Auroral Charging) code. Report No. 1, March-December 1987.** Tautz, M.F.; Cooke, D.C.; Rubin, A.G.; Yates, G.K. (Radex, Inc., Carlisle, MA (USA)). 18 Dec 1987. 86p. (RX—871218). NTIS, PC A05/MF A01.

This report documents the input and output considerations for the computer code MACH, and the analytical models incorporated therein. Actual FORTRAN and C coding is not given. MACH has been designed to study Mesothermal Auroral CHarging, and other problems requiring a self-consistent steady-state solution of Poisson's equation with precise kinetic transport of charged particles. The solution space is two-dimensional (axisymmetric) in configuration space, and three-dimensional in velocity space. MACH code features include: limited object-definition capability; Poisson's solution by hybrid SOR; stationary or drifting Maxwellian plasma; and a collisionless Vlasov approximation to particle transport, solved by a reverse trajectory 'inside-out method' augmented with a velocity-space topology search algorithm.

9750 **(AD-A—198946/6/XAB) Energetic particles and ion-composition experiment for crres. Interim technical report.** Quinn, J.M.; Vondrak, R.R. (Lockheed Missiles and Space Co., Palo Alto, CA (USA)). 30 Jun 1988. 67p. NTIS, PC A04/MF A01.

The ONR-307 Energetic Particles and Ion Composition instrument payload will measure the energetic particle and plasma environment of the Earth's radiation belts and inner plasma sheet. The payload has been successfully designed, built, and tested for flight on the Combined Release and Radiation Effects Satellite. The instruments were integrated with the spacecraft and tested with the integrated system. This mission, originally scheduled for shuttle launch in July 1987, will now be launched on an Atlas Centaur in June, 1990. The ONR-307 payload is currently undergoing final adjustments and calibration activities prior to re-integration with the spacecraft in May 1989. Procedures have been developed and documented for on-orbit operation of the payload and acquisition of the data on digital tapes.

9751 **(AD-A—198948/2/XAB) ELF scattering in the earth-ionosphere waveguide. Interim report, January-August 1988.** Pappert, R.A.; Hitney, L.R. (Naval Ocean Systems Center, San Diego, CA (USA)). Apr 1988. 128p. (NOSC/TD—1275). NTIS, PC A07/MF A01.

Slab-model implementation of ELF scattering by a cylindrically symmetric but radially varying ionospheric disturbance is explored. The ground-based transmitter and receiver may be located beneath the disturbance or outside its projection on the ground. Amplitudes and phases of the laterally dependent part of all transverse magnetic (TM) field components are calculated as a function of range for a given location of the disturbance or as a function of disturbance location for a fixed range. Although partial sum-convergence difficulties limit its general utility, the resulting program can be used for a variety of case studies. Examples given include drifting sporadic-E patches, a nuclear depression, and a weak solar-proton event.

9752 **(AD-A—199150/4/XAB) Fluctuations associated with sheared-velocity regions near auroral arcs.** Basu, B.; Coppi, B. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). May 1988. 5p. NTIS, PC A02/MF A01.

Pub. in Geophysical Research Letters, Vol. 15, No. 5, 417-420(May 1988).

The theory of electrostatic, collisional plasma modes that are driven unstable by a sheared-field aligned ion-flow velocity is presented. It is shown that the linear instability provides a direct means of exciting the observed sub-km scale irregularities in the auroral F region. The spectral characteristics of the density and the electric-field fluctuations that can be inferred from the theory are found to be consistent with the observations.

9753 **(AD-A—199181/9/XAB) New concepts in ionospheric modification. Final report, 15 April 1986-30 September 1987.** Banks, P.M.; Fraser-Smith, A.C.; Gilchrist, B.E.; Harker, K.J.; Storey, L.R. (Stanford Univ., CA (USA). Space, Telecommunications and Radioscience Lab.). Apr 1987. 182p. (D—131-1). NTIS, PC A09/MF A01.

This report considers the ionospheric modification that can be produced by energetic charged-particle and photon beams, which are emitted from a platform or vehicle (spacecraft or rockets) located in the ionosphere. The various beams considered include (1) charged-particle beams composed of low-, moderate-, and high-energy electrons, (2) beams of ions and plasma, and (3) photon beams of soft x rays and extreme-ultraviolet radiation. Briefly considered, in addition to the beam topics, is the ionospheric modification produced by the release of neutral gas of high molecular weight from a rapidly moving vehicle such as the Space Shuttle Orbiter. When a ranking is made in terms of the new information that may be obtained, the scale of the modification that may be produced, and the availability of beam sources, ionospheric modification by means of relativistic electron beams appears particularly promising. However, all the methods have their own distinctive features that could make their use desirable under particular circumstances. The modification produced by means of beams of soft x rays, for example, is not strongly dependent on the beam's direction relative to the earth's magnetic field, and thus modification can be produced in regions inaccessible to a charged-particle beam from the same vehicle.

9754 **(AD-A—199235/3/XAB) Electromechanical feedback processes in the ionosphere. Final technical report, 1 December 1984-31 May 1988.** Forbes, J.M. (Boston Univ., MA (USA). Dept. of Electrical Computer and Systems Engineering). 31 Aug 1988. 7p. NTIS, PC A02/MF A01.

The general goals were to provide a better understanding of observed neutral and plasma structures in the upper atmosphere, and to define appropriate parameterizations for the neutral-plasma interactions governing these structures in comprehensive numerical models of the thermosphere and ionosphere. A convection model was utilized to investigate the electrodynamic coupling between the magnetosphere and thermosphere including the effects of neutral winds, and noting the change in electric fields penetrating to low latitudes due to the wind effects. A unique aspect of the study is that the high-latitude convection-driven winds are included self-consistently and interactively; that is, a steady-state wind parameterization was derived analytically in terms of the electric potential, which is in turn included in a closed-loop calculation for the electric potential itself. An analogous study was performed for the thermosphere-ionosphere system, wherein the balance height of the F layer was expressed analytically in terms of the meridional neutral wind, and the two parameters allowed to evolve self-consistently within dynamical calculations representing magnetically disturbed and quiet conditions in the thermosphere. In another series of calculations, plasma structures unique to the equatorial ionosphere were modeled analytically and incorporated into a numerical solution of the neutral dynamics to demonstrate the controlling influence of the ionosphere on the equatorial thermosphere.

**9755 (AD-A—199301/3/XAB) Linear transport theory of auroral-proton precipitation: a comparison with observations. Report for June 1986-June 1987.** Basu, B.; Jasperse, J.R.; Robinson, R.M.; Vondrak, R.R.; Evans, D.S. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Jun 1987. 6p. (AFGL-TR—88-0191). NTIS, PC A02/MF A01.

Pub. in Journal of Geophysical Research, Vol. 92, No. A6, 5920-5932(1 Jun 1987).

This reprint presents nearly coincident Chatanika radar electron-density measurements and NOAA 6 particle data for a continuous (diffuse) auroral E layer with a peak electron density of 100000 to 2001000/cc produced entirely by proton precipitation. The radar and particle data are analyzed using the Jasperse-Basu transport theoretic method and the semiempirical, continuous slowing down method of Rees. Comparisons between the radar results for the electron-density profile and the two theoretical results are given. It is concluded that the transport theoretic method of Jasperse and Basu gives a more-accurate result for the shape of the electron-density profile and for the location of its peak than the semi-empirical, continuous slowing-down method of Rees. The transport theoretic method is applied to derive a closed-form expression for the energy-deposition function, and the transport theoretic energy-deposition function is compared with that used by Rees in order to explain the differences in the electron-density profiles obtained by the two theoretical methods.

**9756 (AD-A—199423/5/XAB) Program of support for HIPAS campaigns during 1987. Final report.** Olson, J.V. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). 1988. 16p. NTIS, PC A03/MF A01.

This is a review of the work performed during the 1987 HIPAS campaigns through 30 September 1987. During 1987, two campaigns were undertaken, one in June and one in October, to establish the level of very low frequency modulation that could be accomplished using the HIPAS radar facility to heat the polar ionosphere. During the June campaign, it was established that there was sufficient current flowing in the ionosphere to enable the heater to produce detectable modulation at almost every interval. Further, using measurements of the polarization of the VLF return on could infer the direction of the current being modulated. Data were fortuitously taken during the passage of a westward travelling surge associated with a substorm onset in the College (Alaska) area. The analysis of this event is included in this report.

**9757 (AD-A—199424/3/XAB) Thermospheric winds in the geomagnetic polar cap for solar-minimum conditions.** Meriwether, J.W.; Killeen, T.L.; McCormac, F.G.; Burns, A.G. (Michigan Univ., Ann Arbor (USA). Space Physics Research Lab.). 1 Jul 1988. 17p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 93, No. 7, 7478-7492(1 Jul 1988).

A Fabry-Perot interferometer located at Thule, Greenland (Delta = 86) has monitored the F-region thermospheric neutral wind over the northern hemisphere geomagnetic polar cap during the 1985/1986 solar-minimum, winter-solstice period. The wind observations were obtained by determining the Doppler shift of the (O I) 15,867-K (630.0-nm) emission. Three factors make the data-set unique and particularly valuable for a study of the effects of the deposition of energy and momentum from the magnetosphere into the high-latitude neutral thermosphere. These factors are (1) the proximity of the observing station to the geomagnetic pole, (2) the continuous nature of the coverage due to the high geographic latitude and polar night conditions, and (3) the fact that the data set was obtained near solar minimum. The measured winds are compared with the simulations of the NCAR thermospheric general circulation model (TGCM). The results show that winds in the geomagnetic polar cap have a fundamental diurnal character, in accord with model predictions, with typical speeds of approx. 200 m/s, generally in an antisunward direction. A large degree of variability, however, in both the magnitude and direction of the winds is observed, including evidence for curvature in the neutral flow within the instrumental region of observation (approx. 400 km diameter). Acceleration of the meridional component across Thule is observed at times. This acceleration is ascribed to regions of ion-drag forcing associated with the magnetospheric input of energy and momentum. Characteristic asymmetric wind signatures were seen that were well correlated with positive or negative changes in the By component of the interplanetary magnetic field.

**9758 (AD-A—199454/0/XAB) Plasma theory and simulation. Quarterly progress report Nos. 3-4, 1 July-31 December 1987.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 31 Dec 1987. 55p. NTIS, PC A04/MF A01.

A magnetized plasma next to an absorbing wall is simulated, showing positive wall charging causing a large E-field near the wall, then a large ExB drift, then a Kevlin-Helmholtz instability, vortices, and coalescence. Particle transport to the walls is Bohm-like for Omega sub pl > Omega sub ci. A kinetic theory, allowing finite ion Larmor radii, general magnetic-field geometries and plasma equilibria, was developed for hydromagnetic Alfven waves excited within the Earth's magnetosphere by the storm-time energetic ring-current particles. Multi-time and space scaling for bounded plasmas is being developed using an implicit method. It is found that, using large time steps, (Omega sub ce) (Delta t > 1) provides reliable guiding-center motions for single particles. Electron-neutral elastic scattering is added to ES1 readily. Runs with initial beam verify predictions. RF heating (ECRH) is shown to work well with PIC simulations, providing results very similar to a Monte Carlo RF heating code.

**9759 (AD-A—199510/9/XAB) Electron loss and the determination of electron concentrations in the D-region.** Swider, W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1988. 13p. (AFGL-TR—88-0243). NTIS, PC A03/MF A01.

Pub. in PAGEOP, Vol. 127, No. 2-3, 403-414(1988).

The most-meaningful way to compare observations of the daytime D region under all ionization conditions, for the purpose of improving our understanding of this region, would appear to be through use of the effective electron recombination coefficient, psi = q/E2, where q is the ionization production rate, and where E is the electron concentration. This ratio apparently increases monotonically with decreasing altitude, and is much less variable than its components q and e. This parameter appears eminently suitable as a best first-order solution to e after determining q. For nighttime conditions, psi is more sensitive to q. However, an accurate but simple formula exists for the calculation of electron concentrations.

**9760 (DP-MS—88-82) Overview and first results from project STABLE [STAble Boundary Layer Experiment].** Weber, A.H.; Kurzeja, R.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1988]. Contract AC09-76SR00001. 16p. (CONF-890133—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002026/JAW.

From 6. joint conference on applications of air pollution meteorology; Anaheim, CA, USA (29 Jan 1989).

The STABLE project (STAble Boundary Layer Experiment) is a multiyear research effort conceived in 1984 by the Savannah River Laboratory (SRL) and planned by several research groups to study turbulence and diffusion in the stable boundary layer (SBL). The program was jointly planned by Department of Energy (DOE) affiliated laboratories and universities including SRL, Atmospheric Turbulence and Diffusion Division (ATDD) of the National Oceanic and Atmospheric Administration (NOAA), Argonne National Laboratory (ANL), North Carolina State University (NCSU), and The Pennsylvania State University. STABLE's goals are to determine the spatial and temporal distribution of turbulent events during the nighttime, to determine the validity of present models and theories in describing the structure and evolution of the SBL, to determine the role of waves and intermittent turbulence in dispersing chemicals, and to determine better parameterization for describing the mean state and intermittent events in the SBL. By taking advantage of special facility, the program seeks to economize effort and cost. 1 ref., 7 figs.

**9761 (TRITA-EPP—87-02) Measurement of quasi-static and low frequency electric fields on the Viking satellite.** Block, L.P.; Faelthammar, C.G.; Lindqvist, P.A.; Marklund, G.T.; Mozer, F.S.; Pedersen, A. (Royal Inst. of Techn., Stockholm (SE). Dept. of Plasma Physics; Univ. of California, Berkeley (US). Space Sciences Lab.; ESTEC, Noordwijk (NL). Space Science Dept.). (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics). Mar 1987. 1p. NTIS (US Sales Only), PC A03/MF A01 - Also available from: Royal Inst. of Techn. Dept of Plasma Physics, S-100 44 Stockholm, Sweden.. Order Number DE88756210/JAW.

The instrument for measurement of quasi-static and low frequency (dc and slow varying) electric fields on the Viking satellite is described. The instrument uses three spherical probe pairs to measure the full three-dimensional electric field vector with 18.75 ms time resolution. The probes are kept near plasma potential by means of a controllable bias current. A guard covering part of the booms is biased to a negative voltage to prevent photoelectrons escaping from the probes from reaching the satellite body. Current-voltage sweeps are performed to determine the plasma density and temperature and to select the optimal bias current. The bias currents to the probes and the voltage offset on the guards as well as the current-voltage sweeps are controlled by an on-board microprocessor which can be programmed from the ground and allows great flexibility. (authors).

**9762 (TRITA-EPP—88-01) Snapshots of high-latitude electrodynamics using Viking and DMSP/F7 observations.** Marklund, G.T.; Blomberg, L.G.; Stasiewicz, K.; Murphree, J.S.; Pottelette, R.; Zanetti, L.J.; Potemra, T.A.; Hardy, D.A.; Rich, F.J. (Royal Inst. of Techn., Stockholm (SE). Dept. of Plasma Physics; Swedish Inst. of Space Phys., Kiruna (SE); Univ. of Calgary (CA); Centre de Recherches en Physique de l'Environment Terrestre et Planetaire, Saint-Maur-des-Fosses (FR); Johns Hopkins Univ., Laurel (US). Applied Phys. Lab; Air Force Geophysics Lab., Bedford (US). Space Physics Lab.). (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics). Feb 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - Also available from: Royal Inst. of Techn., Dept. of Plasma Physics, S-100 44 Stockholm, Sweden.. Order Number DE88756211/JAW.

Simultaneous observations by the Viking and the DMSP/F7 satellites have been used in a new method to obtain snapshot pictures of the auroral electrodynamics. In particular, an 'instantaneous' global equipotential (or convection) pattern is calculated using field-aligned current and conductivity distributions that are qualitatively consistent with the Viking auroral imager data and quantitatively consistent with magnetic field and particle data from the two satellites. This convection pattern which is of the normal two-cell type, with a weak dusk cell and a strong, elongated crescent-shaped dawn cell (consistent with positive IMF B/sub y/) agrees well with the Viking electric field data. The model and the observed potential profiles agree nicely along the entire Viking orbit except for two intervals above acceleration regions where deviations are to be expected (due to parallel electric fields). These regions are characterized by: U-shaped potential minima, upward field-aligned currents, upgoing ion beams and relatively intense AKR. The model results are thus consistent with the Viking observations not only on a global scale but also on the scale size of the auroral acceleration regions. The corresponding convection in the magnetosphere is illustrated by a simple projection of the deduced two-cell convection pattern to the equatorial plane. From this the instantaneous location of the plasmapause is inferred. (authors).

## 6403 Atomic, Molecular, And Chemical Physics

*REFER ALSO TO CITATION(S) 8522, 8878, 8885, 9634, 9636, 9639, 9747, 10124*

**9763 (AD-A—197642/2/XAB) Symmetries of spontaneous decay for atoms near any surface. Technical report.** Arnoldus, H.F.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Jun 1988. 44p. (UBUFFALO/DC—88/TR-76). NTIS, PC A03/MF A01.

The structure of spontaneous decay of atoms in the vicinity of a surface is shown to be determined by spatial symmetries. The spontaneous-decay operator for a degenerate two level atom is derived, and with symmetry considerations the number of free parameters is reduced to two. Only the dimensionless and normalized inverse lifetimes b-parallel and b-perpendicular for a parallel and perpendicular dipole moment with respect to the surface, respectively, enter the expression for the relaxation operator for any atom near any surface. These two parameters incorporate the atom-surface-distance dependence of all Einstein coefficients for spontaneous decay, and all optical properties of the substrate material. It is shown that the specific features of spontaneous decay are mainly geometrical, and a consequence of symmetries of the vacuum radiation field, irrespective of the presence of the atom. With an example, it is shown how the parameters b-parallel and b-perpendicular can be calculated in a particular case. It is also pointed out that an explicit quantization of the radiation field can be avoided, even though the process of spontaneous emission is purely quantum mechanical.

**9764 (AD-A—197996/2/XAB) Modifying excitation transfer cross sections with an ac Stark effect.** Coutts, J.; Cooper, J.; Burnett, K. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). May 1988. 5p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 13, No. 5, 354-356(May 1988).

It is possible to manipulate electronic energy-transfer collision cross sections between different atomic species by using a strong electromagnetic field close to resonance with a transition between two excited states to modify the energy levels (i.e., to create dressed states), which may be placed in or out of resonance with populated states (forming a population reservoir) in one of the species. The authors c.utline an estimate for a transfer cross section for a demonstration scheme and show that cross-section enhancements up to the order of 1000 are possible.

**9765 (AD-A—198271/9/XAB) Electron-impact excitation of the $N_2$i meinel band.** Piper, L.G.; Green, B.D.; Blumberg, W.A.; Wolnik, S.J. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 7p. (AFGL-TR—88-0175). NTIS, PC A02/MF A01.

Pub. in Jnl. of Physics B: Atomic and Molecular Physics, Vol. 19, 3327-3332(1986).

The authors measured rates for the excitation of vibrational levels 2-7 of the A 2 pi/sub u/ state of the diatomic nitrogen cation by electron impact on $N_2$ relative to each other and to $N_2^+$. These rates are consistent with Franck-Condon factors for ionization, previous laboratory measurements and high-latitude auroral observations. The total cross section for production of the $N_2^+$ state by the impact of electrons between 2.5 and 6.0 kV on $N_2$ is 4.0 + or - 0.7 times as large as the production rate for the B state. Given the invariance with energy in the ratio of the electron impact cross sections for A-state production to those for B-state production at energies greater than 50 eV, the result implies a total cross section for A-state production at 100 eV.

**9766 (AD-A—198277/6/XAB) Atomic and molecular alignment from photoelectron angular distributions in (n+1) resonantly enhanced multiphoton ionization.** Dubs, R.L.; McKoy, V.; Dixit, S.N. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics). 15 Jan 1988. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 88, No. 2, 968-974(15 Jan 1988).

Two distinct (n + 1) REMPI techniques for obtaining the alignment of gas-phase atom molecules from photoelectron angular distributions are presented. In both methods, the alignment is extracted from the angular distributions independently of the photoionization dynamics. The first method, which takes advantage of circular dichroism in the angular distributions (CDAD) has already been established experimentally as a useful probe of state alignment. The theory outlined in previous work is expanded here. The second method involves photoionization with light linearly polarized along the photoelectron collection direction and is presented here for the first time.

9767 **(AD-A—198481/4/XAB) Ionization rates relevant to laser cooling of hydrogen. Final report, 1 August 1987-31 January 1988.** Turley, R.S. (Hughes Research Labs., Malibu, CA (USA)). Jun 1988. 51p. NTIS, PC A04/MF A01.

Laser cooling of atomic hydrogen has practical importance is a wide variety of applications ranging from relativistic neutral-particle beam weapons to atomic clocks and exotic fuels. A laser beam suitable for atomic hydrogen cooling needs to be high-intensity, narrow-band, coherent, and broadly tunable in the region around Lyman-alpha (1216 A). The author produced a source meeting these criteria. He studied, characterized, and optimized this source for conditions important to laser cooling. In an introductory section, he discusses the physics and potential practical applications of laser cooling and tunable VUV sources. Specific results obtained during the six months of this contract.

9768 **(AD-A—199088/6/XAB) Inelastic helium-scattering studies of the surface vibrational spectroscopy and dynamics of ordered Ar, Kr, and Xe multilayers physisorbed on Ag(111). Interim technical report.** Gibson, K.D.; Sibener, S.J. (Chicago Univ., IL (USA). Dept. of Chemistry). Jun 1988. 21p. (TR—13). NTIS, PC A03/MF A01.

This is the second of three papers discussing the authors studies of overlayers of argon, krypton, and xenon physisorbed on Ag(111). All of these rare gases form ordered structures, which are azimuthally aligned but translationally incommensurate with the Ag substrate. This paper discusses experiments wherein they utilized the angle-resolved time of flight of inelastically scattered 18-meV He atoms to examine the surface dynamics of multilayer rare gas films along the r - M direction. This was done on a layer-by-layer basis for 2, 3, and >20 layers for each of the rare gases. Unlike the monolayers, the vibrational modes observed for the multilayers show dispersion across the surface Brillouin zone, the amount of dispersion increasing with the number of adsorbed layers. These results reveal in detail how the surface dynamical properties of a thin film evolve towards those of a thick crystal as a function of increasing dimension. Lattice-dynamics calculations, which utilize realistic gas-phase pair potentials, reproduce the experimentally observed phonon dispersion relations quite well. The authors also examine the inelastic-scattering probabilities and linewidths of the transitions.

9769 **(AD-A—199089/4/XAB) Elastic helium-scattering studies of ordered overlayers of Ar, Kkr, and Xe physisorbed on Ag(111). Interim technical report.** Gibson, K.D.; Sibener, S.J.; Cerjan, C.; Light, J.C. (Chicago Univ., IL (USA). Dept. of Chemistry). Jun 1988. 32p. (TR—14). NTIS, PC A03/MF A01.

Experiments are described that measured the angle-resolved intensity of helium (Ei=18 and 66 meV) elastically scattering from the surfaces of rare-gas overlayers physisorbed on Ag(111). These studies were done on a layer-by-layer basis for 1, 2, 3, and 25 ordered overlayers of argon, krypton, and xenon. Two types of experiments are described. The first is diffraction, where the scattered-helium intensity was measured as a function of the detector angle, with the incident polar and azimuthal angles held constant. In the second type of experiment, selective adsorption, the specular intensity was measured as a function of incident angle. The purpose of these experiments was to examine the helium-surface potential, to assess the relative contributions that various helium-rare gas pair potentials, nonadditive multibody terms, and helium-substrate interactions make to the systems studied. The experiments are compared with the results of accurate close-coupling calculations, in order to quantitatively perform these assessments. The comparisons between the selective adsorption data and scattering calculations demonstrate the extreme sensitivity that such measurements have to the helium-surface potential.

9770 **(AD-A—199407/8/XAB) Effects of autoionizing resonances on electron-impact excitation rates for Be-like ions.** Chen, M.H.; Crasemann, B. (Oregon Univ., Eugene (USA)). 15 Apr 1988. 9p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 37, 2886-2892(15 Apr 1988).

The effects of autoionizing resonances on the electron-impact excitation rates for n=2 to n=2 intrashell transitions in beryllium-like ions have been studied for six ions with atomic numbers Z = 30, 34, 36, 42, 47, and 54. The resonance contributions to the excitation rates were calculated in the isolated-resonance approximation. Detailed Auger and radiative rates were evaluated in the multiconfiguration Dirac-Fock model. Results are compared with background rates from the Coulomb-Born-exchange approximation. Autoionizing resonance have been found to enhance the electron-impact excitation rates by a factor of 2-4 for the electric-dipole-forbidden transitions, while for dipole-allowed transitions, the resonance effects amount to only a few percent of these rates.

9771 **(AD-A—199542/2/XAB) New class of cross sections for use in atomic-scattering calculations. Interim report.** Mueller, G.P. (Naval Research Lab., Washington, DC (USA)). 16 Sep 1988. 36p. (NRL-MR—6292). NTIS, PC A03/MF A01.

It is useful to have simple cross sections to represent the interactions between particles when performing transport-theory calculations for range, energy deposition, and damage by impinging ions on bulk materials. This report presents a number of families of finite-range interactions that are simple to generate during such transport calculations. These cross sections have a Thomas-Fermi character at large energy transfers and a wide variation of behavior for small energy transfers. The potentials that correspond to these cross sections are displayed graphically, so that if one has a phenomenologically derived potential between two constituents, one can read off the graphs which family member will give a good representation of that interaction.

9772 **(BNL—41963) A positronium beam and positronium reflection from LiF(100).** Weber, M.; Tang, S.; Berko, S.; Brown, B.L.; Canter, K.F.; Lynn, K.G.; Mills, A.P. Jr.; Roellig, L.O.; Viescas, A.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8808122—11). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004536/JAW.

From 8. international conference on positron annihilation; Gent, Belgium (29 Aug 1988).

We report results obtained from a variable energy monoenergetic beam of positronium (Ps). Ps was formed by a charge transfer reaction of positrons colliding with Ar gas atoms in a "gas cell" with an efficiency of about 3 {times} 10/sup {minus}4/. The beam was used to measure the fraction, R, of specularly reflected ortho-Ps from LiF(100). We found R to peak at about 30% for 7 eV Ps at a specular scattering angle of 50{degree} to 60{degree}. At higher energies R drops sharply to values around 0.5% near 60 eV Ps.

9773 **(BONN-IR—88-27) Application of the close-coupling and the integral-equation method to the atomic three-particle problem.** Oehm, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Jun 1988. 122p. (In German). Bonn Univ. (Germany, F.R.). Physikalisches Inst.

This thesis deals with the application of the Fadeev-like AGS integral equations of the many-channel scattering theory and the close-coupling method to the atomic three-particle problem. Especially both elastic scattering processes for the electron-hydrogen and the positron-hydrogen case and inelastic reaction cross sections for the positron production in the ore gap are calculated. Hereby methodical questions about the comparison of the different applied procedures hold the spotlight. (orig./HSI).

9774 **(CBPF-NF—015/88) Molecular invariants: atomic group valence.** Mundim, K.C.; Giambiagi, M.; Giambiagi, M.S. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705007/JAW.

Molecular invariants may be deduced in a very compact way through Grassman algebra. In this work, a generalized valence is defined for an atomic group; it reduces to the Known expressions for the case of an atom in a molecule. It is the same of the correlations between the fluctions of the atomic charges qc and qd (C belongs to the group and D does not) around their average values. Numerical results agree with chemical expectation.

**9775 (CONF-881002—32) Multiphoton ionization photoelectron spectroscopy of xenon: Experiment and theory.** Bajic, S.J.; Compton, R.N.; Tang, X.; L'Huiller, A.; Lambropoulos, P. (Oak Ridge National Lab., TN (USA); University of Southern California, Los Angeles (USA). Dept. of Physics). Nov 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004182/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Photoelectron energy and angular distributions for resonantly enhanced multiphoton ionization (REMPI) of xenon via the three-photon-allowed $7s[3/2]_1^o$ and $5d[3/2]_1^o$ states have been studied both experimentally and theoretically. The electron kinetic energy spectra give the probability of leaving $Xe^+$ in either the $^2P$/sub 1/2/ or $^2P$/sub 3/2/ core. The measured branching ratio for leaving each ionic core is used to test the theoretical description of the REMPI process. Measurements of both the angular distributions and the [3+1] REMPI via the 5d state are adequately reproduced by multichannel quantum defect theory. However, measurements of angular distributions for the electrons resulting from [3+1] via the $7s[3/2]_1^o$ state into $Xe^+$ $^2P$/sub 3/2/ (core preserving) or $Xe^+$ $^2P$/sub 1/2/ (core changing) are in striking disagreement with theory. 1 ref., 2 figs.

**9776 (CONF-881002—35) New coherent cancellation effect involving four-photon excitation and the related ionization.** Payne, M.G.; Garrett, W.R.; Judish, J.P.; McCann, M.P. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004800/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

We describe here an effect which occurs when a first laser is tuned near a dipole allowed three-photon resonance and a second laser is used to complete a dipole allowed four-photon resonance between the ground state {vert←bar}0 > and an excited state {vert←bar}2 >. In this process three photons are absorbed from the first laser and one photon from the second; so that if the {vert←bar}0 >–{vert←bar}2 > transition is two-photon allowed the transition is also pumped resonantly by the third harmonic field due to the first laser and the second laser field. When the second laser is strong enough to cause strong absorption of the third harmonic light, and the phase mismatch, {DELTA}κ is large and dominated by the nearby resonance, a destructive interference occurs between the pumping of the {vert←bar}0 >–{vert←bar}2 > transition by two- and four-photon process. 7 refs.

**9777 (CONF-881002—36) Effect of the coherent cancellation of the two-photon resonance on the generation of vacuum ultraviolet light by two-photon reasonantly enhanced four-wave mixing.** Payne, M.G.; Garrett, W.R.; Judish, J.P.; Wunderlich, R. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004799/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Many of the most impressive demonstrations of the efficient generation of vacuum ultraviolet (VUV) light have made use of two- photon resonantly enhanced four-wave mixing to generate light at ω/sub VUV/ = 2ω/sub L1/ +- ω/sub L2/. The two-photon resonance state is coupled to the ground state both by two photons from the first laser, or by a photon from the second laser and one from the generated VUV beam. We show here that these two coherent pathways destructively interfere once the second laser is made sufficiently intense, thereby leading to an important limiting effect on the achievable conversion efficiency. 4 refs.

**9778 (CONF-881002—37) Suppression of two-photon resonantly enhanced nonlinear processes in extended media.** Garrett, W.R.; Moore, M.A.; Payne, M.G.; Wunderlich, R.K. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004796/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

On the basis of combined experimental and theoretical studies of nonlinear processes associated with two-photon excitations near 3d and 4d states in Na, we show how resonantly enhanced stimulated hyper-Raman emission, parametric four-wave mixing processes and total resonant two-photon absorption can become severely suppressed through the actions of internally generated fields on the total atomic response in extended media. 7 refs., 3 figs.

**9779 (CONF-881002—38) Photodetachment of He/sup {minus}/: Angular distributions of photoelectrons.** Thompson, J.S.; Pegg, D.J.; Compton, R.N.; Alton, G.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004930/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Energy- and angle-resolved photoelectron detachment spectroscopy has been used to study the spectral dependence of the angular distributions of electrons photodetached from a beam of He/sup {minus}/ ions. 5 refs., 1 fig.

**9780 (CONF-881151—44) High precision measurements of hyperfine structure in Tm II, $N_2$i and Sc II.** Mansour, N.B.; Dinneen, T.P.; Young, L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004263/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

We have applied the technique of collinear fast-ion-beam laser spectroscopy to measure the hyperfine structure (hfs) in Sc II, Tm II and $N_2^+$. Laser induced fluorescence was observed from a 50 keV ion beam which was superimposed with the output of an actively stabilized ring dye laser (rms bandwidth <1 MHz). Hyperfine measurements were made in the metastable $3d^2$ and the excited 3d4p configuration of Sc II and in the $4f^{13}6s$ and $4f^{13}5d$ configurations of the Tm II. The fine and hyperfine structure of $N_2^+$ has been observed in the (0,1) and (1,2) band of $B^2\Sigma$/sub u/ $^+${minus}$X^2\Sigma$/sub g/$^+$ system. Higher resolution measurements of the metastable $3d^2$ configuration in Sc II were also made by laser-rf double resonance. The experimental results will be compared with those obtained by multiconfiguration Hartree-Fock ab-initio calculations. 15 refs., 4 figs., 5 tabs.

**9781 (CONF-8809134—2) Desorption of $Cs^+$ ions with fast incident atomic and molecular ions.** Salehpour, M.; Hunt, J.E.; Tou, L.C.; Hedin, A.; Sundqvist, B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003958/JAW.

From 2. international workshop on MeV and KeV ion and cluster interactions with surfaces and materials; Orsay, France (5 Sep 1988).

Preliminary results on desorption yield measurements of secondary $Cs^+$ ions, desorbed as a result of the impact of $C^+$, $O^+$, $CO^+$, $O_2^+$, $CO_2^+$ and $C_4H_9^+$ incident ions, in the energy range of 950 keV--3.5 MeV are presented. Molecular beams are found to give high yields of secondary $Cs^+$ as a result of impact of $O_2^+$ compared to $O^+$ incident ions, indicate no "collective" molecular effects. 23 refs., 1 fig.

**9782 (CONF-8809134—3) The roles of electronic and nuclear stopping in the desorption valine negative molecular ions.** Hunt, J.E.; Salehpour, M.; Fishel, D.L.; Tou, J.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003943/JAW.

From 2. international workshop on MeV and KeV ion and cluster interactions with surfaces and materials; Orsay, France (5 Sep 1988).

The yield of valine negative molecular ions has been measured as a function of $Xe^+$, $Kr^+$, and $Ar^+$ primary ion velocity. The electronic and nuclear stopping powers are comparable in magnitude and opposite in slope in the experimental velocity region. The yield data are explained in terms of electronic stopping power alone, with no contribution from nuclear stopping power within the experimental error. Low molecular weight atomic species are found

to be best described by a nuclear stopping power related process. 18 refs., 3 figs.

9783 **(CONF-8810242—2) Production of atomic negative ion beams of the Group IA elements.** Alton, G.D.; Mills, G.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004183/JAW.

From Symposium of Northeastern Accelerator Personnel; New Haven, CT, USA (24 Oct 1988).

A method has been developed which enables the direct sputter generation of atomic negative ion beams of all members of the Group IA elements (Li, Na, K, Rb, and Cs). The method consists of the use of sputter samples formed by pressing mixtures of the carbonates of the Group IA elements and 10% (atomic) Cu, Ag, or other metal powder. The following intensities are typical of those observed from carbonate samples subjected to {approximately}3 KeV cesium ion bombardment: $Li^-$: ≧0.5 μA; $Na^-$: ≧0.5 μA; $K^-$: ≧0.5 μA; $Rb^-$: ≧0.5 μA; $Cs^-$: ≧0.2 μA. 7 refs., 2 figs., 1 tab.

9784 **(DOE/ER/13332—T1) Spectroscopic studies of hydrogen atom and molecule collisions: Progress report.** Kielkopf, J. (Louisville Univ., KY (USA)). 9 Sep 1988. Contract FG05-85ER13332. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004333/JAW.

This work is concerned with the effect of neutral collisions on the formation of spectral lines, their profiles and intensities. Our interest is in collisions in which a hydrogen atom or molecule participates, since such systems are tractable for theoretical modeling, while their low mass and closely spaced energy levels offer unique experimental phenomena. Progress on these problems in the last year is summarized here.

9785 **(DOE/ER/53217—2) Theoretical atomic physics for fusion: 1988 annual report.** Pindzola, M.S. (Auburn Univ., AL (USA). Dept. of Physics). 29 Aug 1988. Contract FG05-86ER53217. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004324/JAW.

This paper discusses progress in atomic physics in the following areas: Electron-impact ionization of atomic ions; electron-impact excitation of atomic ions; Dielectronic recombination of atomic ions; and relativistic effects on electron-ion scattering. (LSP)

9786 **(DOE/ER/60474—2) Biophysical studies related to energy generation: Progress report.** Green, A.E.S. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). 21 Nov 1988. Contract FG05-86ER60474. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004864/JAW.

This report covers work subsequent to our previous report of December 24, 1986. At that time we were groping to find relationships between vibrational and rotational electron impact cross sections in the vapor and liquid phases of water. Having reached an impass within the radiological literature, we drew upon the atmospheric, oceanographic and flame radiation literatures. Here a much broader body of excitation energy and intensity data related to the vibrational and rotational excitation of water in the vapor phases and liquid phases enabled us to identify certain "big bands" of $H_2O$. These bands account for the major infrared absorption features observed in atmospheric transmission studies as well as important spectral radiation features observed in hydrocarbon combustion. Related liquid phase-gas phase involvement also entered our work on co-combustion of biomass and waste, and natural gas in studies directed toward contributing to the solution of national energy-environmental and economic problems. Attachments to this report include our published works, submitted works, and in complete studies related to radiological, atmospheric, and combustion studies which encompass biophysical studies related to energy generation and which have a common thread involving water in liquid and vapor form. These works are tied together in this brief report, along with some comments on trends in science and technology which they might illustrate.

9787 **(FRCEA-TH—116) Study of ionizing collisions involving excited states in a potassium-rubidium mixture at thermal energy.** Djerad, M.T. (Paris-11 Univ., 91 - Orsay (France)). 1987. 202p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88756143/JAW.

This study concerns mainly ionising collisions involving excited states in a saturated mixture of K-Rb vapours, at thermal energy. The experimental method consists into continuous resonant two steps laser excitation of the atoms (n ≦ 10) and mass spectrometry of ion currents. Radiative and collisional relaxation of the atoms create a complex medium. The most efficient collisional processes are Penning ionisation and Hornbeck-Molnar ionisation. In the heteronuclear system Rb(n1) + K(4P), the following exit channels may be operative: Rb(n1) + K(4P) -> Rb/sup +/ + e/sup -/ + K Rb(n1) + K(4p) -> K/sup +/ + e/sup -/ + Rb Rb(n1) + K(4P) -> KRb/sup +/ + e/sup -/. The measurements show that the first channel has an average cross section {similar←to} 10/sup -13/ cm/sup 2/. Those of the other channels are at least three orders of magnitude smaller and thus comparatively negligible. The data obtained from 5D to 10S allow to conclude that the flux in the entrance channel ionises at large separation between Rb(n1) and K(4P). The process of ionisation is dominated by polarisation forces, exchange forces being negligible. In the present mixture, Hornbeck-Molnar ionisation leads to homonuclear molecular ions K/sub 2//sup +/, Rb/sub 2//sup +/ as well as the heteronuclear one KRb/sup +/. We have measured the rate coefficients for the systems: K(n1) + Rb -> KRb/sup +/ + e/sup -/Rb(n1) + K -> KRb/sup +/ + e/sup -/. The rate coefficients increase with the excitation energy of the level n1; they do not exhibit fundamental differences with those measured in pure alkali vapours.

9788 **(GSI—88-12) Positron spectroscopy on subcritical collisional systems.** Huchler, S. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.)). May 1988. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755941/JAW.

Aim of this thesis is to measure the positron production in subcritical collisional systems in the neighbourhood of the Coulomb threshold. Studied were the collisional systems U-Ta, U-Au, and Pb-Pb. Additionally the supercritical system U-U was measured at the energies with E/A=5.6 MeV/u and 5.9 MeV/u. In all three subcritical collisional systems coincidently to the scattered heavy ions (15/sup 0/ ≦θsub p/ ≦55/sup 0/) two line-like structures over the smooth continuum of atomic and nuclear positrons were found. The widths of these lines amount to ≈30 keV, the energies of these lines lie at ≈255 keV and ≈342 keV, the cross section for the line production scales with Z/sub u/ proportional to Z/sub u// sup 22/. (orig./HSI).

9789 **(GSI—88-44-Prepr.) Higher-order vacuum polarization charge densities for spherical symmetric external potentials.** Soff, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755948/JAW.

The vacuum polarization contribution of order α(Zα)/sup n/ with n≧ on electron binding energies has been calculated following the prescription of Wichmann and Kroll. The numerical techniques for the evaluation of the vacuum polarization charge density are discussed. Results are presented for atoms with Z=73, 82 and 170, respectively.

9790 **(IFUSP-P—712) Rotational band structure in odd-odd /sup 132/La.** Oliveira, J.R.B.; Emediato, L.G.R.; Rizzutto, M.A. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). May 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705099/JAW.

High spin states in /sup 132/La have been excited by (/sup 10/B,4n) and (/sup 11/B,3n) reaction on/sup 126,124/Te targets. Excitation functions, angular distributions and γ,γ coincidences were used. A rotational band, possibly based on a (PIh11/2 x vh11/2 configuration, has observed for the first time.

**9791** (INIS-BR—1366) **Variational method in the atomic structure calcularion.** Tomimura, A. (Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil)). 1970. 104p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705162/JAW.

The importance and limitations of variational methods on the atomic structure calculations is set into relevance. Comparisons are made to the Perturbation Theory. Ilustrating it, the method is applied to the H/sup -/, H/sup +/ and H/sup +//sub 2/ simple atomic structure systems, and the results are analysed with basis on the study of the associated essential eigenvalue spectrum. Hydrogenic functions (where the screening constants are replaced by variational parameters) are combined to construct the wave function with proper symmetry for each one of the systems. This shows the existence of a bound state for H/sup -/, but no conclusions can be made for the others, where it may or may not be necessary to use more flexible wave functions, i.e., with greater number of terms and parameters.

**9792** (INIS-BR—1369) **Thermal behaviour of the Bi profile implanted in bilayer systems.** Olivieri, C.A. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1987. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705165/JAW.

Implantations of Bi ions into bilayer systems formed by Al films with 1550, 610 e 1000 (angstrom) of thickness evaporated on substrates of Ti,KCL and V respectively are performed. The experiments were made with two main purposes: (1) To compare the implanted ion profiles with the theoretical predictions of the most recent version of the Monte-Carlo simulation program (code TRIM), developed by Biersack and Haggmark, which use the nuclear and electronic stopping powers, based on the universal potential and on the proton stopping power respectively. (2) To study the implanted ion behaviours after isochronal thermal annealings. The depth profiles were analysed via the Rurherford Backscattering Spectroscopy (RBS) technique. The TRIM calculated results are in perfect agreement with the experimental profiles, reproducing very well the discontinuities at the film-substrate interfaces. From the thermal annealing studies, the following conclusions are obtained: (i) The film-substrate interfaces work as diffusion barriers for the implanted ions. (ii) In the KCL sample, thermal annealings at temperatures greater then 300/sup 0/C, showed sequential shifts of the Bi profile in the direction of the surface, which were not observed in the Al/KCL system. (iii) The Al/sub 3/Ti phase precipitation was observed in the Al/Ti system after annealing at 500/sup 0/. (iv). The diffusion coefficient of the implanted ions in the Al/V system was found to be D=5x10/sup -5/ exp(-2.2 eV/KT) cm/sup 2//s.

**9793** (INIS-SU—68, pp 239) **Contribution of direct mechanism in ionization process of atom at $\beta$sup +-/ decays.** Batkin, I.S.; Demakov, S.L.; Churakova, T.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

**9794** (INIS-SU—68, pp 240) **One-quantum annihilation of positrons with electrons of internal atomic shells.** Batkin, I.S.; Demakov, S.L.; Churakova, T.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

**9795** (INIS-SU—68, pp 483) **Pion capture from continuous spectrum in IS mesic atom state.** Birbrair, B.L.; Gridnev, A.B.; Kalashnikov, Yu.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

**9796** (IPPCZ—277/II, pp 37-39) **Longitudinal diffusion in a magnetized plasma.** Sestak, B.; Ferdinand, J. (Vysoka Skola Strojni a Elektrotechnicka, Plzen (Czechoslovakia)). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

An analytical formula for the longitudinal diffusion coefficient, valid for both two-component (electron-ion) and one-component plasma (self-diffusion), and for an arbitrary value of the external magnetic field, is derived form the kinetic equation for a magnetized plasma by the Chapman-Enskog method. No difference was found in the diffusion coefficients between the case of one-component and of an electron-ion plasma. (J.U.). 1 fig., 4 refs.

**9797** (IPPCZ—277/II, pp 55-63) **Application of pulsed high-power generators for plasma investigation in IPPLM.** Bartnik, A.; Karpinski, L.; Janowski, A. (Instytut Fizyki Plazmy i Laserowej Mikrosyntezy, Warsaw (Poland)). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

In a survey of the IPPLM (Institute of Plasma Physics and Laser Microsynthesis) activity in the field of high-current electron and ion beams, the electron accelerators NIKE-M, NIVA and NIKE-3 are described and a brief summary of experimental results is presented. With the first accelerator NIKE-M the processes of electron beam formation and focusing were studied as was the collective acceleration of ions from the anode foil plasma. The anode foil ablation was first investigated using the NIKE-3 accelerator. Recently, micropinch experiments with imploding metallic and glass wires started. The NIVA accelerator is being rebuilt into low-impedance facility OMEGA-6. (J.U.). 4 figs., 4 refs.

**9798** (IPPCZ—277/II, pp 69-81) **Some laser and plasma methods of particle acceleration (Survey).** Kolomenskij, A.A. (AN SSSR, Moscow. Fizicheskij Inst.). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Laser-plasma and collective methods of particle acceleration are surveyed. Out of thirteen nonconventional methods listed in the paper, the following five are discussed in detail: 1. Quasilinear particle acceleration (reversed free electron laser); 2. Two-beam accelerator and field transformer; 3. Acceleration in plasma waves excited by laser beams; 4. Acceleration in plasma waves excited by electron clusters; 5. Grating accelerator (dropletron). The physical principles of the above mentioned methods are explained and the achievable acceleration rates estimated. The maximum acceleration rates are believed to amount to 1 GeV/m. For the time being it is, however, very difficult to say which method will be the first to find its practical application. (J.U.). 33 refs.

**9799** (IPPCZ—277/II, pp 86-92) **Numerical simulation of high current relativistic electron flow.** Vrba, P.; Ullschmied, J.; Clupek, M.; Astrelin, V.T. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Two-dimensional relativistic electromagnetic current-line code "POISSON2" was used for the simulation of beam particles dynamics in a high-current high-voltage vacuum diode. Different cathode shapes and beams propagating in a vacuum or through a plasma in metallic drift tubes were investigated. The total diode currents for flat, conical and concave diodes were calculated. The convergence of the iteration process and the shapes of the calculated electron trajectories are shown. (J.U.). 4 figs.

9800 (JINR—D-14-87-799, pp 152) **Single-charged muon clusters in hydrogen, helium and neon.** Sidorenko, A.D.; Smilga, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89780035/JAW. (CONF-8706161—).

From 2. international conference on muon and pion interactions in matter; Dubna, USSR (30 Jun 1987).

9801 **(JINR—D-14-87-799) Muons and pions in matter. Proceedings of the International symposium on muon and pion interactions with matter.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. Vp. (In Russian). (CONF-8706161—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89780035/JAW.

From 2. international conference on muon and pion interactions in matter; Dubna, USSR (30 Jun 1987).

Individual papers are separately indexed. (LEW)

9802 **(KFK—4347) Degree of ionization of isolated exotic atoms.** Bacher, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Jan 1988. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755967/JAW.

Completely ionized exotic atoms facilitate high-precision-experiments in a two-body-system. The ionization of muonic and antiprotonic atoms via formation and deexcitation processes is studied. The measurements of yields and energies of circular orbits show complete ionization in the case of anti pNe, anti pAr, anti pKr, $\mu$Ne and $\mu$Ar; anti pXe and $\mu$Kr are highly ionized. X-ray-transitions originating from the electron shell demonstrate the subordinate role of antiproton capture accompanied by the emission of a K-electron to form anti pKr. The pressure dependence of the electron transfer processes to the $\mu$Ne-ion is investigated. Below 500 mbar charge exchange is excluded during the lifetime of the metastable 2s-level.

9803 **(UCID—21577) Relativistic atomic structure I.** Snyderman, N. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004603/JAW.

A framework is presented for relativistic atomic structure calculations that systematically accounts for radiative corrections and electron correlation corrections to the Dirac-Fock approximation. A high Z atomic system is considered to be an interacting relativistic Fermi gas in a background Coulomb field from the nucleus, and is analyzed by quantum field theory. 6 refs.

9804 **(UWThPh—1988-28) Radiative meson decays in chiral perturbation theory.** Ecker, G. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705232/JAW.

Radiative meson decays are a fertile field for chiral perturbation theory. Chiral symmetry together with gauge invariance yield stringent constraints on radiative decay amplitudes. In addition to predicting decay rates and spectra, the chiral approach allows for a unified description of CP violation in radiative K decays. The chiral viewpoint in the recent controversy over the magnitude of two-photon exchange in the decay K/sub L/-> $\pi$/sup 0/e/sup +/e/sup -/ is exposed. The radiative decay eta->$\pi$/sup 0/$\gamma\gamma$ is discussed as an intriguing case where the leading result of chiral perturbation theory seems to be too small by two orders of magnitude in rate. 32 refs., 3 figs.

9805 **Shape resonance and non-Franck—Condon effects in (2+1) resonant enhanced multiphoton ionization of $O_2$ via the C $^3$Pi/sub g/ state.** Braunstein, M.; Stephens, J.A.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **90**: No. 2, 633-640(15 Jan 1989).

We report vibrationally resolved photoelectron angular distributions for photoionization of the C $^3$Pi/sub g/ Rydberg state of $O_2$. Comparison is made with recent experimental measurements of angular distributions which employ (2+1) resonant enhanced multiphoton ionization of the C $^3$Pi/sub g/ state. The present theory treats the process as single-photon ionization from an unaligned Rydberg state, and qualitatively accounts for much of the observed trends. Non-Franck—Condon effects induced by the k$\sigma$/sub u/ shape resonance lead to a substantial dependence of the angular distributions on the vibrational state of the X $^2$Pi/sub g/ ion. Discrepancies between our theoretical results and experiment are qualitatively discussed and tentatively attributed to residual electron correlations.

9806 **Double-resonance studies of rotational autoionization of $H_2$.** O'Halloran, M.A.; Dehmer, P.M.; Pratt, S.T.; Dehmer, J.L.; Tomkins, F.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **90**: No. 2, 930-948(15 Jan 1989).

Two-color resonantly enhanced multiphoton ionization combined with photoelectron spectroscopy detection was used to study rotational autoionization of np Rydberg states of $H_2$ near the first ionization threshold. In this two-step experiment, one laser was used to excite a two-photon transition to the E,F $^1\Sigma^+$/sub g/, v' = E0, J' = 0—4 levels, and a second laser was used to probe single photon transitions to the rotationally autoionized np Rydberg series coverging to the X $^2\Sigma^+$/sub g/, $v^+ = 0$, N-bar$^+ = 1$—6 rotational levels of the ion. Assignments were made for a large number of Rydberg states converging to $v^+ = 0$ and for several interlopers converging to $v^+ = 1$ and 2. Of the five dipole allowed Rydberg series converging to $v^+ = 0$ excited from each intermediate J' level (J'>2), two are allowed to rotationally autoionize in a coupling scheme that assumes ejection of pure p waves in the ionization process and singlet coupling of the spins of the ion core and the outgoing electron. Members of these Rydberg series have large half-widths, and the v dependence of the half-widths is in good agreement with simple quantum defect theory predictions. Ionization via the change of four quanta of rotational energy was found to be significantly slower than ionization via the change of two quanta of rotational energy.

9807 **Model Hamiltonians for atomic and molecular systems.** Carlson, J.; Moskowitz, J.W.; Schmidt, K.E. (Theoretical Division, Los Alamos National Laboratory, T5 MSB283 Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **90**: No. 2, 1003-1006(15 Jan 1989).

A model Hamiltonian, designed to allow larger systems to be treated with the Green's function Monte Carlo method, is introduced for atomic and molecular systems. The model reduces the statistical variance associated with Green's function Monte Carlo calculations by reducing potential energy fluctuations in the core regions. By performing calculations of Li, LiH, and $Li_2$ we show that this method can be used to obtain energy differences with much less computer time than required for the complete interaction. Increases in efficiency for larger systems will be even greater.

9808 **Gaussian basis sets for use in correlated molecular calculations. I. The atoms boron through neon and hydrogen.** Dunning T.H. Jr. (Theoretical & Computational Chemistry Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **90**: No. 2, 1007-1023(15 Jan 1989).

In the past, basis sets for use in correlated molecular calculations have largely been taken from single configuration calculations. Recently, Almloef, Taylor, and co-workers have found that basis sets of natural orbitals derived from correlated atomic calculations (ANOs) provide an excellent description of molecular correlation effects. We report here a careful study of correlation effects in the oxygen atom, establishing that compact sets of primitive Gaussian functions effectively and efficiently describe correlation effects if the exponents of the functions are optimized in atomic correlated calculations, although the primitive (sp) functions for describing correlation effects can be taken from atomic Hartree—Fock calculations if the appropriate primitive set is used. Test calculations on oxygen-containing molecules indicate that these primitive basis sets

describe molecular correlation effects as well as the ANO sets of Almloef and Taylor. Guided by the calculations on oxygen, basis sets for use in correlated atomic and molecular calculations were developed for all of the first row atoms from boron through neon and for hydrogen. As in the oxygen atom calculations, it was found that the incremental energy lowerings due to the addition of correlating functions fall into distinct groups. This leads to the concept of correlation consistent basis sets, i.e., sets which include all functions in a given group as well as all functions in any higher groups.

9809 **High lying gerade Rydberg states of molecular iodine.** Wu, M.; Johnson, P.M. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794-3400). *Journal of Chemical Physics;* **90**: No. 1, 74-80(1 Jan 1989).

Two new (2+1) multiphoton ionization spectra of gerade Rydberg states of molecular iodine are observed in the 310.0—322.5 and the 285.5—295.5 nm ranges. These spectra were obtained in both a conventional MPI cell and in a TOF molecular beam apparatus. A long progression in the 310.0—322.5 nm range is suggested to be 2/sub g/($^2$Pi/sub 3/2//sub g/)nd$\sigma$/sub g/, having a band origin at 62 440 cm$^{-1}$. Three progressions in the 285.5—295.5 nm range are suggested to be 2/sub g/, 1/sub g/, 0/sub g/($^2$Pi/sub 3/2//sub g/)(n+1)d$\sigma$/sub g/, having band origins at 68 335, 68 407, and 68 434 cm$^{-1}$, respectively. The photodissociation behavior of molecular iodine in a MPI process is discussed.

9810 **Anomalous line shapes in delayed optical—optical double resonance studies of $N_2$.** Li, L.; Chupka, W.A.; Pratt, S.T. (Sterling Chemistry Laboratory, Yale University, New Haven, Connecticut 06511). *Journal of Chemical Physics;* **90**: No. 1, 606-608(1 Jan 1989).

Anomalous dips are observed in time-delayed, ionization-detected optical—optical double resonance (OODR) experiments on molecular nitrogen. These dips arise from the competition between radiative decay and photoionization of the upper level of the probe transition, and are therefore of considerable potential importance in the application of ionization-detected OODR to molecules.

9811 **Emittance growth and image formation in a nonuniform space-charge—dominated electron beam.** Reiser, M.; Chang, C.R.; Kehne, D.; Low, K.; Shea, T.; Rudd, H.; Haber, I. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **61**: No. 26, 2933-2936(26 Dec 1988).

An experiment was designed to check theoretical predictions of charge homogenization and emittance growth in nonuniform space-charge—dominated beams due to conversion of field energy into transverse kinetic energy. Five beamlets were masked out of a solid 5-keV electron beam and injected into a periodic solenoidal focusing channel. Phosphor screen images showed that the beamlets merged into a uniform density single beam. Experimental results on merging distance and emittance growth were compared with theory and simulation and good agreement was found.

9812 **Angular momentum distributions of autoionizing states produced by 1.5—5-MeV $C^+$ ions in carbon foils.** Yamazaki, Y.; Stolterfoht, N.; Miller, P.D.; Krause, H.F.; Pepmiller, P.L.; Datz, S.; Sellin, I.A.; Scheurer, J.N.; Andriamonje, S.; Bertault, D.; and others. (Hahn-Meitner-Institut Berlin, Glienicker Strasse 100, D-1000 Berlin 39, Germany). *Physical Review Letters;* **61**: No. 26, 2913-2916(26 Dec 1988).

Orbital-angular-momentum (l) distributions of ions in intermediate n and l states have been compared for 1.5—5-MeV carbon ions traversing C foils and He gases by projectile Auger spectroscopy. The degree of high-l enhancement in C targets is quantitatively established. A picture involving multiple collisions between target atoms and the entrained electrons which accompany the ions explains the results.

9813 **Production of high—angular-momentum Rydberg states by stochastic collisions.** Burgdoerfer, J.; Bottcher, C. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996). *Physical Review Letters;* **61**: No. 26, 2917-2920(26 Dec 1988).

Projectile-centered Rydberg states of highly charged fast ions traversing thin solid targets show an unexpected abundance of high-l states. We present a theory for the production of high-l states based on classical stochastic dynamics. Diffusion into high-l states is shown to be universal for single-particle orbits in three dimensions under the influence of a stochastic perturbation, i.e., largely independent of the details of the interaction potentials. Monte Carlo simulations using a Langevin equation for stochastically perturbed electrons in a dynamically screened Coulomb field yield quantitative agreement with experimental data.

9814 **Frequency shift and asymmetric line shape of the fourth anti-Stokes component from a hydrogen Raman shifter.** Glab, W.L.; Hessler, J.P. (Argonne National Laboratory, Chemistry Division, 9700 South Cass Avenue, Argonne, Illinois 60439). *Applied Optics;* **27**: No. 24, 5123-5126(15 Dec 1988).

We have measured the spectral properties of the fourth anti-Stokes component of the output of a pressurized, molecular hydrogen, Raman shifter pumped by the intense output of a frequency-doubled narrowband pulsed dye laser. All the observed line shapes are asymmetric, with full widths at half-maximum ranging from 0.3 to 0.8 cm/sup -1/. The spectral peak of the Raman-shifted light varies linearly with the intensity of the pump light and is given by $\sigma$(rho,I) = $\sigma$(rho) + AI. The previously measured density-dependent Stokes shift is $\sigma$(rho), the intensity of the laser is I, and A is 1.5 +- 0.2 cm/sup -1//(TW/cm$^2$). The electric field-induced shift and asymmetric line shape limit the accuracy and resolution of spectroscopic measurements made with light from a hydrogen Raman shifter. We propose that these observations may be explained by the ac Stark effect in the Raman shifting medium.

9815 **Recommended cross sections for electron capture and ionization in collisions of C/sup q/$^+$ and O/sup q/$^+$ ions with H, He, and $H_2$.** Janev, R.K.; Phaneuf, R.A.; Hunter, H.T. (Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6372). *Atomic Data and Nuclear Data Tables;* **40**: No. 2, 249-281(Nov 1988).

An evaluation has been made of the existing experimental and theoretical cross-section data for electron capture and ionization in collisions of C/sup q/$^+$ and O/sup q/$^+$ ions ($1 \leqq q \leqq Z$) with H, He, and $H_2$. Sets of recommended cross-section data with specified accuracies are presented in the energy range of interest to controlled thermonuclear fusion research. Chebyshev polynomial fits to the recommended data are also given. copyright 1988 Academic Press, Inc.

9816 **Rate coefficients for electron impact excitation of magnesium-like ions.** Pradhan, A.K. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards and University of Colorado, Boulder, Colorado 80309-0440). *Atomic Data and Nuclear Data Tables;* **40**: No. 2, 335-363(Nov 1988).

Maxwellian-averaged collision strengths are presented for ions in the magnesium isoelectronic sequence: S V, Ar VII, Ca IX, CR XIII, Fe XV, and Ni XVII. Results are given for 120 transitions in each ion including fine structure, involving the 16 levels $3s^2$ $^1S_0$, 3s3p($^3$P/sub 0,1,2/, $^1P_1$), $3p^2$($^3$P/sub 0,1,2/, $^1D_2$, $^1S_0$), 3s3d($^3$D/sub 1,2,3/, $^1D_2$), and 3s4s($^3S_1$, $^1S_0$). The collision strengths are obtained in the distorted-wave approximation. The rate parameters are tabulated at a range of temperatures for various applications in laboratory and astrophysical plasmas. copyright 1988 Academic Press, Inc.

## 6404 Fluid Physics

*REFER ALSO TO CITATION(S) 8072, 8158, 8460, 8610, 8684, 8704, 8707, 8713*

9817 **(AD-A—197308/0/XAB) Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall. Final report.** Young, F.J.; Brown, S.H.; Sondergaard, N.A. (David Taylor Research Center, Bethesda, MD (USA)). May 1988. 27p. (DTRC—88/017). NTIS, PC A03/MF A01.

The magnetohydrodynamic equations for temporal transients were formulated and solved for a liquid metal flowing in a rectangular channel. The rectangular channel was a perfectly conducting moving top wall and a perfectly conducting stationary bottom wall in the presence of an applied external magnetic field aligned perpendicular to the conducting walls. The side walls of the channel are stationary insulators. Calculations show that the temporal transients of the fluid velocity and induced magnetic intensity comprise two exponentially decaying parts. One fast transient is believed to be associated with the propagation of Alfven waves and the other a slow transient being the result of viscous and electrical diffusion. Curves of the transients are presented at several stations in the channel.

9818 **(B—8705589) Experimental setup for the study of polarized $He^3$ and dilute $He^3$-$He_4$ mixtures. Ph.D. Thesis, 4 December 1986.** Vermeulen, G.A. (Rijksuniversiteit Leiden (Netherlands)). 1987. 159p. (ETN—88-92897). NTIS, PC A08/MF A01.

Properties of highly polarized liquid He3; a dilution refrigerator for use with the study of polarized liquid He3 and nuclear cooling; a continuous wave nuclear magnetic resonance spectrometer; Pomeranchuk cooling in high magnetic fields; experiments on polarized liquid He3; and a nuclear demagnetization system to cool a 6 percent He3-He4 mixture are discussed.

9819 **(CEA-R—5459) Dynamics of fluid lines, sheets, filaments and membranes.** Coutris, N. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1988. 66p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756238/JAW.

We establish the dynamic equations of two types of fluid structures: 1) lines-filaments and 2) sheets-membranes. In the first part, we consider one-dimensional (line) and two-dimensional (sheet) fluid structures. The second part concerns the associated three- dimensional structures: filaments and membranes. In the third part, we establish the equations for thickened lines and thickened sheets. For that purpose, we introduce a thickness in the models of the first part. The fourth part concerns the thinning of the filament and the membrane. Then, by an asymptotic process, we deduce the corresponding equations from the equations of the second part in order to show the purely formal equivalence of the equations of the third and fourth parts. To obtain the equations, we make use of theorems whose proofs can be found in the appendices. The equations can be applied to many areas of interest: instabilities of liquid jets and liquid films, modelisation of interfaces between two different fluids as sheets or membranes, modelisation with the averaged equations over a cross section of single phase flows and two-phase flows in channels with a nonrectilinear axis such as bends or pump casings.

9820 **(LA-UR—88-3680) Mass transport in propagating patterns of convection.** Moses, E.; Steinberg, V. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 47p. (CONF-8805120—5). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003476/JAW.

From CNLS conference on advances in fluid turbulence; Los Alamos, NM, USA (16 May 1988).

Recent studies of propagating waves in an oscillatory convection of binary mixtures arise questions about transport properties of this flow. Optical visualization of a field of refraction index due to a shadowgraph technique gives information on the temperature and concentration fields. However, experimental observation of rolls propagating along the cell as travelling waves (TW) does not necessarily imply that mass is transferred hydrodynamically by the convective motion along the cell. One of the possibilities discussed, e.g., is that TW observed is only a phase propagation. The traditional examples of such situations come from the domain of linear, superposition-oriented physics. Acoustic waves transfer momentum and energy, but do not cause the mass to make excursions for their equilibrium point that are larger than the oscillation amplitude. In the case of nonlinear physics we were aware that small amplitude surface waves cause only small oscillatory motion round the equilibrium point, while larger amplitudes can cause the mass to start moving in the direction of the TW. This paper discussed the different possibilities of mass transfer by TW. 27 refs., 20 figs.

9821 **(LA-UR—88-3702) Statistical theories of Rayleigh-Taylor instability for compressible fluids.** Glimm, J.; Li, X.L.; Zhang, Q.; Menikoff, R.; Sharp, D.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-8810234—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003472/JAW.

From Workshop on the physics of compressible turbulent mixing; Princeton, NJ, USA (24 Oct 1988).

Statistical theories for the outer envelope of the Rayleigh-Taylor mixing layer refer to a simplified dynamics of fundamental modes and their interactions. These modes are bubbles of light fluid entrained in the mixing layer between the undisturbed light and heavy fluids. The dynamics can be understood in terms of the motion of a single mode and the interactions between modes. The single mode dynamics has to be solved self-consistently in a background field of random bubbles. The dominant interaction is bubble merger, i.e., the spreading of larger bubbles at the bubble envelope. Merger leads to dynamically increasing length scales, and thus to a dynamic renormalization of scaling dimensions. The mechanism for bubble merger is the differential motion of physically adjacent single bubble modes. This paper is focused on the above topics: single bubble motion, bubble interactions and statistical models. 10 refs., 4 figs., 2 tabs.

9822 **(NAL-TR—954) Special characteristics of arc-heated low density plasma flows. Argon plasma.** Watanabe, Yasuo; Hirabayashi, Noriaki. (National Aerospace Lab., Chofu, Tokyo (Japan)). Dec 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755747/JAW.

Characteristics of Argon stream is an arc heated type low density wind tunnel was analyzed by means of a spectrophotometric measurement of natural emission which accompanied the stream. the spectrum analysis gave the following results: (1) In the plenum chamber, the electron temperature and the electron density were measured and were compared with the gas temperature obtained by the enthalpy measurement. Although there is a big temperature difference in a region of low enthalpy, the bi-temperature state gradually increases with the increase of enthalpy showing the possibility of attaining an equilibrium state at 80 or more of non-dimensional enthalpy. (2) Change of electron temperature was measured at in-nozzle expansion flow and the free flow at measured position. As predicted, this showed a large non-equilibrium from the gas temperature. (3) It was found that the origin of long duration emission of low density gas stream was contributed by the reunionized radiation and meta-stable atom. (22 figs, 1 tab, 24 refs)

9823 **(SAND—88-0917C) Verification of a Navier-Stokes code for solving the hypersonic blunt body problem.** Blottner, F.G. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 12p. (CONF-890151—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003169/JAW.

From 4. symposium on numerical and physical aspects of aerodynamic flows; Long Beach, CA, USA (16 Jan 1989).

Computational results obtained from a Navier-Stokes code for the subsonic nose region flow on blunt bodies in supersonic flow have been evaluated for accuracy. The unsteady thin-layer form of the governing equations for a perfect gas are solved with a linearized block Alternating-Directions Implicit finite-difference solution procedure. A modification to the usual numerical scheme is required near the stagnation point to obtain satisfactory heat transfer results in this region. Sensitivity of the solutions to code input parameters is investigated. Predictions obtained from the code are presented an compared to numerical and experimental results. This study indicates that very accurate surface pressures and reasonably accurate heat transfer predictions are obtained from the code. 13 refs., 13 figs., 7 tabs.

9824 **Turbulent energy at an ablating surface.** Mikaelian, K.O. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Applied Physics;* **65**: No. 3, 964-968(1 Feb 1989).

We calculate the turbulent energy generated at a surface which is accelerating by ablation. The ablation velocity V/sub a/

reduces the growth rate n(k) from its classical value for the Rayleigh—Taylor instability. This reduction is reflected in our general expression for E/sub turbulent/, valid for arbitrary V/sub a/, which we derive on the basis of the Canuto—Goldman model for turbulence [Phys. Rev. Lett. 54, 430 (1985)]. Out results are analytic and they reduce to particularly simple forms in the classical (V/sub a/→0) and strongly inhibited (V/sub a/→∞) limits, where we find E/sub turbulent/ = (2/3)(56/9π)²Ag/$k_0$ and E/sub turbulent/ = (8Ag/3π$k_0$V/sub a/)², respectively.

**9825 Hydrodynamic interactions and the viscosity of suspensions of freely moving spheres.** Ladd, A.J.C. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics;* **90**: No. 2, 1149-1157(15 Jan 1989).

A computational method aimed at calculating the hydrodynamic interactions between spherical particles, within the framework of the "creeping-flow" approximation, is developed further. The basic fluid equations for a system with periodic boundary conditions have been rederived, paying particular attention to possible divergences in the fluid velocity field. Numerical results have been obtained for the viscosity of a suspension of freely moving hard spheres over a range of solid densities from the dilute limit to near the hard-sphere freezing transition.

**9826 Intermolecular potentials for liquid argon.** Ross, M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics;* **90**: No. 2, 1209-1211(15 Jan 1989).

Properties of liquid argon calculated using an accurate variational theory, show that the intermolecular potentials of Barker and Aziz give equivalent results and that the three-body Axilrod—Teller term is essential for quantitative agreement with experiment.

**9827 Doublet splitting and the low-field evolution of the real squashing modes in superfluid $^3$He-B.** Fishman, R.S.; Sauls, J.A. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6032 and Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review Letters;* **61**: No. 25, 2871-2874(19 Dec 1988).

We consider the effects of textures on the collective-mode spectrum of $^3$He. Our result for the frequency splitting of the real-squashing-mode doublet agrees well with the measurements of Shivaram et al. The smooth disappearance of the doublet and the nonlinear evolution of the real-squashing-mode frequencies at low magnetic fields are explained in terms of a crossover to the dispersion-dominated regime when (qv/sub F/)³/Δ>γH.

**9828 Temperature dependence of S(Q,ω) in liquid $^4$He under pressure.** Talbot, E.F.; Glyde, H.R.; Stirling, W.G.; Svensson, E.C. (Department of Physics, University of Delaware, Newark, Delaware 19716). *Physical Review [Section] B: Condensed Matter;* **38**: No. 16, 11229-11244(1 Dec 1988).

The temperature dependence of the dynamic form factor, S(Q,ω), of liquid $^4$He at p = 20 bars has been determined by inelastic neutron scattering measurements. Two wave vectors, Q = 1.13 A/sup -1/ and Q = 2.03 A/sup -1/, corresponding to the maxon and roton regions of the phonon-roton dispersion curve, were studied over a wide range of energy transfer, (h/2π)ω. Based on previous data at SVP, Woods and Svensson proposed that S(Q,ω) could be represented as a sum of two components, one proportional to the superfluid density, rho/sub S/(T), and one proportional to the normal density rho/sub N/(T). The component proportional to rho/sub S/(T) contained the sharp one-phonon peak which vanished at T = T/sub λ/. The aim here is, firstly, to present data on the temperature dependence of S(Q,ω) at 20 bars and, secondly, to explore whether or not the Woods-Svensson decomposition of S(Q,ω) holds at higher pressure. At 20 bars and for the Q values investigated here, we find that the sharp peak of S(Q,ω) does indeed decrease rapidly in intensity as T increases and the corresponding excitation either vanishes or changes abruptly in character at T/sub λ/.

## 6450 High Energy Physics

**9829 (DOE/ER/01112—13) Studies of elementary particles: Progress report and proposal.** Chapman, J.W. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 6 May 1988. Contract AC02-76ER01112. 136p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004942/JAW.

This progress report discusses the following High Energy Physics topics: the IMB/MIA detector; the MKII/HRS detector; the cosmic gamma-ray experiment; computer and instrumentation services; the MACRO detector; the DO detector; and spin physics. (LSP)

**9830 (DOE/ER/03956—7) Elementary particle interactions, Task A: Progress report, October 1, 1987--November 15, 1988.** Bugg, W.M.; Brau, J.E.; Condo, G.T.; Handler, T.; Hart, E.L.; Ward, B.F.L.; Close, F.E. (Tennessee Univ., Knoxville (USA). Dept. of Physics). Nov 1988. Contract AS05-76ER03956. 16p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004327/JAW.

This paper discusses the data from high energy physics experiments on proton and meson beam incident on bubble chambers, photoproduction, and high energy neutrino interactions. Also discussed is the SLD detector at the SLAC Linear Collider. (LSP)

**9831 (DOE/ER/40118—T2) Research in particles and fields and their interactions: Technical progress report, November 1986--December 30, 1988.** Yildiz, A. (Boston Univ., MA (USA)). 1988. Contract AC02-83ER40118. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005070/JAW.

This paper contains information on the following topics: Weak interactions; Field theories; Particle phenomenology; and Cosmology and particle physics. In particular, vector mesons, superstring cosmology, quarkonia systems, and CP-violation are some specific topics discussed. (FL)

## 6451 Particle Interactions And Properties - Experimental

*REFER ALSO TO CITATION(S) 9021, 9080, 9931*

**9832 (BNL—42078) Summary of the 8th international symposium on high energy spin physics.** Bunce, G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 14p. (CONF-880983—19). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004524/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

The series of conferences on high energy spin physics dates back to Argonne, 1974, and the first use of the polarized proton beam at the ZGS. This conference is unique in that it is concerned both with the technology of spin and with particle physics: particle physicists need to know what experiments might be possible and target/beam/source physicists want to know what their work will lead to, and get new ideas. In many cases, and I believe that this is central to the success of spin physics and of this conference series, these are the same people. This summary will have three basic parts: where we are now relative to Argonne in 1974; a discussion of new experiments and theory---there were many new and intriguing results presented here; and new ideas for polarized sources, beams, and targets which point toward an exciting future program of particle physics. 13 refs., 2 figs., 4 tabs.

**9833 (BONN-IR—88-06) Measurement of the differential cross sections of the reaction γ+p -> π/sup +/+n at mean production angles and photon energies from 735 to 2005 MeV and parametrization of the c.m. angular distributions in the energy range from 300 to 1985 MeV.** Heise, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Feb 1988. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755934/JAW.

In this experiment the differential cross sections of the reaction $\gamma p \rightarrow \pi^+ n$ in the photon energy interval from 735 MeV to 2005 MeV under the pion laboratory angle of 33/sup 0/ and 60.8/sup 0/ were measured. (orig./HSI).

**9834 (BONN-IR—88-12) Measurement of the differential cross section of the reactions $\gamma+p \rightarrow \pi^+ +/+n$ and $\gamma+p \rightarrow \pi^0 +/+p$ at a laboratory angle of 45 degrees in the gamma enery range from 0.8 GeV to 2.0 GeV as well as parametrization of the c.m. angular distributions by Legendre polynomial expansion.** Zenz, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Mar 1988. 155p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755935/JAW.

After closure of the optimization work of the magnetic spectrometer 'Porthos' in the framework of this thesis it was begun with the data acquisition and evaluation for the determination of the differential cross sections for the reactions $\gamma+p \rightarrow \pi^+ +/+n$ as well as $\gamma+p \rightarrow \pi^0+p$. The measurements were performed at a laboratory angle of 45 degrees relative to the direction of the incident photon beam whereby the latter reaction was measured simultaneously to the $\pi^+ +/$ production because of the kinematics by detection of the recoil proton. The gamma energy range in the laboratory system extended for the $\pi^+ +/$ reaction between 790 MeV and 2010 MeV in the c.m. angle interval from 69.2 degrees to 87.6 degrees. The measurements for the $\pi^0 +/$ photoproduction comprehended the laboratory energy range from 810 MeV to 2010 MeV for center-of-mass angles between 81.7 degrees and 72.1 degrees. (orig./HSI).

**9835 (CERN-EP—88-124) A search for glueballs in the central region in the reaction pp → p/sub f/($X^0$p/sub s/ at 300 GeV/c using the CERN {OMEGA} spectrometer.** Armstrong, T.A.; Benayoun, M.; Beusch, W.; Bloodworth, I.J.; Caponero, M.; Carney, J.N.; Childs, R.; French, B.R.; Ghidini, B.; Goldschmidt-Clemont, Y. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Sep 1988. 30p. (CONF-880867—15). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89003183/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

The aim of this experiment is to search for gluonic mesons in the reaction pp→p/sub f/($X^0$)p/sub s/ at 300 GeV/c incident proton momentum, where the $X^0$ system is a centrally produced meson. Preliminary results are presented on the two-body ($\pi^+\pi^-$, $K^+K^-$, $K^0_S K^0_S$, $p\bar{p}$), three body ($K^0_S K^\pm\pi^\mp$) and four-body ($2\pi^+2\pi^-$) decays of the $X^0$ system. 19 refs., 20 figs., 7 tabs.

**9836 (CONF-8809203—2) $\pi^0$ and photon spectra from central and peripheral $^{16}O$ + Au collisions at 200 A GeV.** Santo, R.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Clewing, G.; Dragon, L. (Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA)). 1988. Contract AC05-84OR21400;AC03-76SF00098. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004801/JAW.

From 7. international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, United States (26 Sep 1988).

The production of neutral pions by the interaction of 200 A GeV proton and $^{16}O$ projectiles with an Au target has been studied for $1.5 \leqq \{eta\} \leqq 2.1$. Transverse momentum spectra have been measured between 0.4 GeV/c and 2.8 GeV/c and their dependence on the centrality of the reaction has been investigated. The peripheral spectrum shows a marked change of slope with a hard component starting at about 1.8 GeV/c in close similarity to p + p data. Preliminary analyses of photon data yield an excess over known photon sources for central data which is absent for peripheral reactions. 15 refs., 3 figs.

**9837 (DOE/ER/01195—T10) Observation of structure in the phi phi system produced in radiative J/psi decays.** Tripsas, B. (Illinois Univ., Urbana (USA). Dept. of Physics). [1988]. Contract AC02-76ER01195. 173p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89004336/JAW.

A sample of 4.9 million J/{psi} decays from the Mark III detector at SPEAR is used to study the radiative decay J/{psi} → γ{phi}{phi}. The decay is observed in two final states; $\gamma K^+ K^-$/sup {minus}/$K^+ K^-$/sup {minus}/ and the previously unobserved $\gamma K^+ K^-$/sup {minus}/$K^0_S K^0_L$/°. The new final state and an improved analysis of the all charged state allow the observation of a large enhancement in the {phi}{phi} mass spectrum in the region below 2.5 GeV/$c^2$ in addition to the {eta}/sub c/. The product branching ratio B(J/{psi} → γ{eta}/sub c/) {times} B({eta}/sub c/ → {phi}{phi}) is measured in both final states. The branching ratio to the low mass region, B(J/{psi} → γ{psi}{psi}, m({psi}{psi}) < 2.51 GeV/$c^2$) is also measured. The angular distribution of the kaons is used to demonstrate that the enhancement is predominantly pseudoscalar. This effect is similar to what is observed in other radiative decays to two vector mesons and a photon. An upper limit is placed on the production of tensor glueball candidates observed to decay to {psi}{psi} by another experiment. 41 figs., 110 figs., 10 tabs.

**9838 (DOE/ER/10667—T4) Experimental particle physics at the University of Pittsburgh: Progress report, April 1, 1988--March 31, 1989.** Cleland, W.E.; Coon, D.D.; Engels, E. Jr.; Shepard, P.F.; Thompson, J.A. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Dec 1988. Contract AC02-80ER10667. 156p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004488/JAW.

This report discusses the experimental work in particle physics at the University of Pittsburgh. Topics discussed are: lepton production at the CERN SPS; direct photon production at the Tevatron; and search for fractional charge particles in semiconductors. (LSP)

**9839 (DOE/ER/13065—565) Ten years of direct-photon physics.** Ferbel, T. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1988. Contract AC02-76ER13065. 19p. (UR—1097; CONF-881073—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004741/JAW.

From Topical conference on physics in collision; Capri, Italy (19 Oct 1988).

The latest experimental results on direct-photon production in hadronic collisions, and their phenomenologic interpretation are reviewed. Without question, the confrontation between data and theory has provided one of the most impressive triumphs for perturbative QCD. 26 refs., 34 figs.

**9840 (DOE/ER/40261—3) Electron interactions with nuclei: Progress report.** (Virginia Univ., Charlottesville (USA)). Aug 1988. Contract FG05-86ER40261. 57p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004937/JAW.

This paper contains information on the following topics: inclusive electron scattering; electroexcitation of Δ in nuclei; longitudinal and transverse response in the quasi-elastic region; electron scattering at MIT-Bates; detector development at LEGS; electron scattering at Saclay; intermediate energy nuclear interactions; research and development at CEBAF; and computing facilities.

**9841 (DOE/ER/40446—1) Medium energy measurements of N-N parameters: Progress report, January 1, 1988--December 31, 1988.** Riley, P.J. (Texas Univ., Austin (USA). Dept. of Physics). 1 Dec 1988. Contract FG05-88ER40446. 25p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005229/JAW.

We report here progress made for the period January 1, 1988, to December 31, 1988, for the Department of Energy Three-year Grant No. DE-FG05-88ER40446, first year. A major part of the work has been and will continue to be associated with research done at the Nucleon Physics Laboratory (NPL) at the Los Alamos Meson Physics Facility (LAMPF). The aim of the experimental program is the determination of the nucleon-nucleon amplitudes at medium energies. The required data include both elastic and inelastic experiments, and in addition the measurement of polarization and polarization transfer parameters. The measurements can be broadly categorized into those of proton-proton elastic scattering, which probe the isospin-1 elastic channel, neutron-proton elastic

scattering, which allow measurements of isospin-0 amplitudes, proton-proton inelastic scattering, and neutron-proton inelastic scattering. We are nearing completion of a long-range series of p-p elastic scattering measurements, and believe that the required goals have been achieved. During the past few years we have emphasized proton-proton inelastic scattering measurements, and believe that the determination of the I = 1 inelastic phase shifts is progressing well. The I = 0 amplitudes, both elastic, and inelastic, are still poorly determined, at best. These measurements require a much more intense polarized neutron beam than is yet available, and therefore have needed the high-intensity optically pumped polarized ion source, due to come on-line during late 1989. During the past year our work emphasized p-p elastic differential scattering cross-section measurements in the energy range 500--800 MeV at LAMPF. The measurements aimed for an absolute accuracy of 1%, and we believe that this was achieved. We also have been involved in what we believe is the first partial wave analysis of pp $\rightarrow$ np$\pi^+$ data.

**9842 (DOE/ER/40452—1) Research and development of a helium-4 based solar neutrino detector: Progress report for period May 1, 1988--April 30, 1989.** Lanou, R.E.; Maris, H.J.; Seidel, G.M. (Brown Univ., Providence, RI (USA). Dept. of Physics). Dec 1988. Contract FG02-88ER40452. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004943/JAW.

This research project is designed to develop and test a new technique for detecting neutrinos using liquid $^4$He in the superfluid state. Following the test results it should be possible to design a practical detector leading to the ultimate goal of detecting low energy solar neutrinos. The project was initiated on May of this year and these first seven months have been devoted to the design and construction of apparatus to carry out these tests. Construction is continuing and is described in this report.

**9843 (DOE/ER/40481—1) Measurement of solar proton-proton fusion neutrinos with a Soviet-American gallium experiment: Technical progress report.** Cherry, M.L. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Nov 1988. Contract FG05-88ER40481. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004369/JAW.

A gallium solar neutrino detector is sensitive to low-energy proton-proton fusion neutrinos. A flux of 70 SNU is expected in a gallium detector from the p-p reaction independent of solar model calculations. If, however, neutrino oscillations in the solar interior are responsible for the suppressed $^8$B flux measured by the Homestake $^{37}$Cl experiment, then a comparison of the gallium and chlorine results may make possible a determination of the neutrino mass difference and mixing angle. A 60-ton gallium detector is currently being constructed in the Baksan laboratory in the Soviet Union, and should be taking data by early 1989.

**9844 (FNAL/C—88/160-E) Neutrino production of charm at FNAL E744.** Foudas, C.; Bachmann, K.T.; Bernstein, R.H.; Blair, R.E.; Lefmann, W.C.; Leung, W.C.; Mishra, S.R.; Oltman, E.; Quintas, P.Z.; Sciulli, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 21p. (CONF-880747—3; EFI—88-72). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004727/JAW.

From 16. annual SLAC summer institute on particles physics; Stanford, CA, USA (18 Jul 1988).

We present data on opposite-sign dimuon production in Fermilab neutrino experiment E744. Opposite-sign dimuons are a clean signature of charm production and provide unique information on the strange component of the nucleon. 12 refs., 11 figs.

**9845 (FNAL/C—88/164-E) Measurement of {var←epsilon}'/{var←epsilon} at Fermilab.** Hsiung, Yee B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 8p. (CONF-8809218—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003927/JAW.

From 9. European symposium on antiproton-proton interactions and fundamental symmetries; Mainz, F.R. Germany (5 Sep 1988).

The current status of the measurement of "direct" CP violation parameters {var←epsilon}'/{var←epsilon} in the Fermilab experiment E731 is reviewed. Preliminary results on upper limit for the decays K/sub L/ $\rightarrow$ $\pi^0$e$^+$ e/sup {minus}/ and $\pi^0$ $\rightarrow$ e$^+$ e/sup {minus}/ (from 20% of the data taken in 1987-88) are also reported. 9 refs., 9 figs., 1 tab.

**9846 (INIS-mf—11840) Threshold measurement of the reaction anti pp -> anti LΛat LEAR.** Frankenberg, R. von. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 17 Dec 1987. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755952/JAW.

1985 a measurement of the experiment PS185 in the threshold region of the reaction anti pp -> anti Λ4L at the antiproton storage ring LEAR of the CERN was performed. The momenta of the incident antiproton beam were 1449.1 MeV/c and 1440.7 MeV/c. A further measuring point at 1550.0 MeV/c was taken in order to obtain high anti Λ4L event rates for polarization studies. By the use of a modularly constructed target in the range between -1 MeV below and 5 MeV above the threshold a measurement of 16 data points was obtained. The evaluation programs reconstructed the produced antiproton momentum with an accuracy of Δ/p ≅2x10/sup -4/. The first touch of the anti Λ4L threshold shows clear evidences for L ≦1 contributions both in the excitation function and in the shape of the differential cross section. The found polarizations above the threshold are in well accordance with earlier measurements and show the typical change of the sign of the polarization at values of the reduced four-momentum transfer -5' ≅0,2(GeV/c)/sup 2/. Furthermore the reaction threshold could be stated at a momentum of (1434.75+-0.43) MeV/c. This result is equivalent with the mass of the Λparticle of m/sub Λ = (1115.54+-0.07) MeV which is in excellent agreement with the currently actual literature value of <m/sub Λ> = (115.566+-0.05g) MeV and can by this be valid as one of the most precise values which was obtained in a single experiment. (orig./HSI).

**9847 (INIS-SU—68, pp 230) Cross section of inverse beta decay reaction and fundamental characteristics of weak interaction.** Mikaehlyan, L.A.; Skorokhvatov, M.D.; Ehtenko, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

**9848 (KFK—4421) Determination of the coupling constant α/sub S/ with energy correlations in multihadronic events.** Gamerdinger, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Sep 1988. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755969/JAW.

Multihadronic events, taken with the detector CELLO at the storage ring PETRA at center-of-mass energies from 14 to 46 GeV have been analyzed. The coupling constant α/sub S/ of quantum chromo dynamics (QCD) has been determined from the asymmetry of the energy-energy correlations (AEEC) and the planar part of the triple energy correlation (PTEC). Results of perturbation theory in 2nd order together with string fragmentation have been used, which were able to reproduce the data well. Systematic uncertainties from different calculations of the 3-jet cross section, correction of the data and choice of the fragmentation model have been studied. The AEEC cannot reasonably be described by models of independent fragmentation. From the values of α/sub S/ at different energies one determines Λsub MS/, the scale parameter of QCD: Λsub MS/=0.42+-0.03+-0.08 (AEEC) and Λsub MS/=0.34+-0.03+-0.05 (PTEC).

**9849 (LBL—26172) Resonance formation in photon-photon collisions.** Gidal, G. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 14p. (CONF-880862—6). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003920/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (28 Aug 1988).

Recent experimental progress on resonance formation in photon-photon collisions is reviewed with particular emphasis on the pseudoscalar and tensor nonents and on the $\gamma\gamma^*$ production of spin-one resonances. 37 refs., 17 figs., 5 tabs.

**9850 (MPI-PAE/Exp.El.—192) Production of D, D/sup */ and D/sub s/ mesons in 200 GeV/c $\pi$/sup -/, K/sup -/ and p-Si interactions.** Barlag, S.; Becker, H.; Buchholz, D.; Dietl, H.; Klanner, R.; Luecking, B.; Luetjens, G.; Lutz, G.; Maenner, W.; Neugebauer, E.; ACCMOR Collaboration. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); European Organization for Nuclear Research, Geneva (Switzerland); Rutherford Appleton Lab., Chilton (UK); Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H; Bristol Univ. (UK); Institute of Nuclear Physics, Krakow (Poland); Valencia Univ. (Spain); Technische Univ. Muenchen (Germany, F.R.)). Jul 1988. 26p. Also published in Z. Phys. C (Jul 1988) v. 39(4) p. 451-460.

The NA32 experiment at the CERN SPS has collected 38 million hadronic interactions with incident 200 GeV/c $\pi$/sup -/, K/sup -/ and p beam. Using a segmented silicon active target and a telescope of high resolution silicon micorstrip counters we have selected fully reconstructed D/sup 0/ -> K/sup -/$\pi$/sup +/, D/sup 0/ -> K/sup -/$\pi$/sup +/$\pi$/sup +/$\pi$/sup -/, D/sup +/ -> K/sup -/$\pi$/sup +/$\pi$/sup +/, D/sub s//sup +/ -> K/sup -/K/sup +/ $\pi$/sup +/ and charge conjugate decays. The integrated cross-sections for D/sup 0/, D/sup +/, D/sup *+/ and D/sub s//sup +/ meson production and the dependence of the cross-section on longitudinal and transverse momentum of the D are presented.

**9851 (MPI-PAE/Exp.El.—193) Hadron production in high energy neutrino and antineutrino collisions.** Schmitz, N. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Aug 1988. 17p. (CONF-8806204—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755977/JAW.

From 13. international conference on neutrino physics and astrophysics; Boston, MA, USA (5 Jun 1988).

New results on hadron production in neutrino and antineutrino nucleon scattering are reviewed. The topics are: multiplicities, resonance production, azimuthal asymmetry, and backward protons.

**9852 (SLAC-PUB—4809) Rare decays of charmed D mesons.** Grab, C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515;AC03-81ER40050;AC02-76ER01195. 1p. (CONF-8811125—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004966/JAW.

From Rare decay symposium; Vancouver, Canada (30 Nov 1988).

We summarize the results of searches for rare decays of the charmed D mesons, based on a data sample of 9.4 pb/sup {minus}{1}/, collected with the MarkIII detector at $\sqrt{S}$ = 3.77 GeV at the $e^+e$/sup {minus}/ storage ring SPEAR. We searched for flavour-changing weak neutral currents and for leptons family number violation in the D{degree}-decay modes D{degree} $\rightarrow \mu e$, D{degree} $\rightarrow e^+e$/sup {minus}/ and D{degree} $\rightarrow$ K{degree} $e^+e$/sup {minus}/. No candidates were observed at a sensitivity to the branching ratios at the 10/sup {minus}{4}/ level. Since couplings of many new intermediate particles in models beyond the Standard Model are expected to be flavour-dependent, these searches in the charmed sector are complementary to the ones performed with leptons and with K- or B-mesons. 9 refs., 3 figs.

**9853** (JINR-D—1,2-86-668-Vol.1, pp 273-278) **Inclusive spectra of kaons and pions produced in relativistic nuclei collisions.** Kurepin, A.B.; Pantuev, V.S. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A19/MF A01. Order Number DE89780026/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

"Caspiy" facility, located in external beam of relativistic nuclei was used to measure cross section of pion and kaon production in collisions of carbon nuclei, deuterons and protons with 3.65 GeV/nucleon energy with carbon and lead nuclei. The yield of negative and positive pions for carbon target is the same. The yield of $\pi$/sup (sup -)/ mesons is higher for lead target. This can be explained by great quantity of neutrons in lead nuclei. Slopes of pion and positive kaon spectra are similar both for collisions of carbon nuclei with carbon and lead nuclei and for deuteron and proton collisions with lead nuclei. It is proposed, that meson production doesn't depend on specific peculiarities of colliding nuclei, but is dictated by common properties of nuclear matter. Approximate comparative evaluation of the dependence of production cross section of vaious types of mesons on the mass of incident A nucleus in $\sigma$ {similar←to} A/sup 2/ parametrization was conducted. The available data were used to obtain the values of $\alpha$=0.67; 0.75 and 1.0 for $\pi$/sup +-/, K/sup +/ and K/sup -/ respectively. 7 refs.; 4 figs.

**9854 Particle production in e/sup +/e/sup -/ annihilation at 29 GeV.** Derrick, M. (Argonne National Lab., Argonne, IL (US)). pp 197-212 of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

Recent results on particle production in e/sup +/e/sup -/ annihilation at 29 GeV are reviewed. The data were obtained using the High Resolution Spectrometer at PEP and correspond to an integrated luminosity of 300 pb/sup -1/. The mean charged particle multiplicity in gluon jets from the three-jet events is found not to differ from that measured for quark jets. The production of the scalar meson S(975) and the tensor mesons $f^0$(1270) and K/sup */ (1430) are observed and the rates are compared to the previously observed vector mesons, rho and K/sup */(890). Finally, some of the global properties of charged particle production are presented and compared with similar results from soft hadronic collisions.

**9855 High-energy hadron-nucleus interactions.** Shepard, W.D.; Mattingly, M.C.K.; Biswas, N.N.; Bishop, J.M.; Cason, N.M.; Kenney, V.P.; Ruchti, R.C.; Ting, S.J.Y.; Neale, W.W.; Elcombe, P.A. (Univ. of Notre Dame, Notre Dame, IN (US)). pp 775-780 of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

Final data samples of 100 GeV/c $\pi$/sup -/, $\pi$/sup +/, rho-bar, rho and K/sup +/ and 320 GeV/C $\pi$/sup -/ interactions with Mg, AG, and Au nuclei obtained in Fermilab E597 are described. The 6207 interactions were observed in the Fermilab 30-inch hybrid bubble chamber spectrometer with Downstream Particle Identifier. All visible charged secondaries were measured. The downstream spectrometer has been used to improve the momentum resolution for fast forward secondaries. Final analyses of the data are in progress. Preliminary results from earlier analyses using partial data samples are discussed to illustrate the types of information which can be obtained from studies of hadron-nucleus interactions.

## 6452 Particle Interactions And Properties - Theoretical

*REFER ALSO TO CITATION(S) 9740, 9890, 9915, 9932, 9934, 9938, 9938, 10010, 10079*

**9856 (BNL—42029) Exotic mesons in {bar N}N annihilation.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880862—7). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004537/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (28 Aug 1988).

We investigate the utility of the antinucleon-nucleon ({bar N}N) annihilation process as a means of producing exotic (non {bar Q}Q) mesons. Several examples are considered of J/sup $\pi$//sup C/ exotic formation in the {bar p}p $\rightarrow \pi$X reaction. We emphasize the usefulness of quantum number filtration, achieved by preparing the initial {bar p}p atom in tagged L = 0,1 states and focusing on selected exclusive final states. 36 refs., 4 tabs.

**9857 (CBPF-NF—021/88) TCP (Truncated Compound Poisson) distribution for particle multiplicity in high energy collisions.** Srivastava, P.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705012/JAW.

On using the Poisson distribution truncated at zero for intermediate cluster decay in a compound Poisson process we obtain TCP distribution which describes quite well the multiplicity distributions in hadronic collisions. A comparison is made between TCP and NB (negative binomial) for UA5 data. The marked features of TCP curves at higher energies are that they are narrower than NB at high multiplicity tail, look narrower at very high energy and develop shoulders and oscillations, not present in NB or other currently proposed distributions, which become increasingly pronounced.

**9858 (CMU-HEP—88-14) Neutrino masses and mixings.** Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). 1988. Contract AC02-76ER03066. 18p. (CONF-880747—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003618/JAW.

From 16. annual SLAC summer institute on particles physics; Stanford, CA, USA (18 Jul 1988).

The neutrino is distinguished from other elementary fermions in that it has only weak interactions. It is produced in the laboratory as a result of weak decays. Like other fermions, neutrinos are believed to exist in three "flavors", $\nu$/sub e/, $\nu$/sub $\mu$/, and $\nu$/sub {tau}/, associated with the charged leptons e, $\mu$, and {tau}, respectively. Each type of neutrino is known to be much less massive than its charged partner. We are concerned in these lectures with theoretical ideas and experimental evidence concerning neutrino mass. I must start by making it clear that there is no definitive experimental evidence and no compelling theoretical argument in favor of a non-zero neutrino mass. It may well be that all neutrinos are massless. However, we will try to show that it is quite natural as one introduces physics beyond the minimal standard electroweak model that neutrinos acquire a small mass. Thus, neutrino mass is of interest in particle physics as a possible window on new physics. In addition, massive neutrinos could be of great importance in cosmology, conceivably providing the dark matter discussed in the lectures by Prof. Hall. Also, effects of neutrino mass could seriously change the detected flux of neutrinos from astrophysical sources, in particular, the neutrinos from the sun. In the first lecture I will concentrate on theoretical ideas, and then I will turn to available and prospective evidence concerning neutrino mass. 32 refs., 3 figs., 3 tabs.

**9859 (CONF-880862—5) Exotic mesons.** Close, F.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004173/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (28 Aug 1988).

I discuss the status of exotic mesons--states that do not fit into the simple q{bar q} model. 17 refs., 1 fig.

**9860 (CONF-880983—17) Where is the proton's spin?.** Close, F.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004193/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

There has been much recent excitement arising from the claim by the EMC collaboration that none of the proton's spin is carried by quarks. There are many textbooks, including those written by some members of this audience, which assert that the proton's spin is carried by quarks. I will review the history of deep inelastic scattering of polarized leptons from polarized protons, culminating in this most recent dramatic claim. I will show that, for the last decade, data have appeared consistent with predictions of the quark model and highlight what the new and potentially exciting data are. I will conclude with suggestions for the future. 33 refs.

**9861 (DOE/ER/40283—6) A potential model investigation of the low-energy antikaon-nucleon interaction and antikaon-nucleus bound states.** Schnick, J.W. (Oregon State Univ., Corvallis (USA)). 5 Jul 1988. Contract FG06-86ER40283. 158p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004640/JAW.

The parameters of separable coupled channels s-wave potentials for the strong {bar K}N interaction are determined from low energy $K^-p$ scattering data with additional constraints from $\pi^-p \rightarrow \pi\Sigma K^0$ production data. The shifts and widths of the Coulomb bound states in kaonic hydrogen are calculated with these potentials and compared with experiment. Optical potentials are constructed from {bar K}N t-matrices derived from the separable potentials, and these optical potentials are used to calculate kaonic helium and kaonic carbon shifts and widths which are also compared with experiment. 68 refs., 50 figs., 9 tabs.

**9862 (DOE/ER/40423—18-P8) Calculating $\epsilon'/\epsilon$ in the standard model.** Sharpe, S.R. (Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract AS06-88ER40423;AC03-76SF00515. 7p. (CONF-8808145—14). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004578/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

The ingredients needed in order to calculate $\epsilon'$ and $\epsilon$ are described. Particular emphasis is given to the non-perturbative calculations of matrix elements by lattice methods. The status of the electromagnetic contribution to $\epsilon'$ is reviewed. 15 refs.

**9863 (DOE/ER/40423—20-P8) Calculations of hadronic weak matrix elements: A status report.** Sharpe, S.R. (Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract AS06-88ER40423;AC03-76SF00515. 31p. (CONF-880747—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004575/JAW.

From 16. annual SLAC summer institute on particles physics; Stanford, CA, USA (18 Jul 1988).

I review the calculations of hadronic matrix elements of the weak Hamiltonian. My major emphasis is on lattice calculations. I discuss the application to weak decay constants (f/sub K/, f/sub D/, f/sub B/), $K^0$ {minus} {bar K{sup 0}} and $B^0$ {minus} {bar B{sup 0}} mixing, $K \rightarrow \pi\pi$ decays, and the CP violation parameters $\epsilon$ and $\epsilon'$. I close with speculations on future progress. 57 refs., 4 figs., 2 tabs.

**9864 (DOE/ER/40427—21-N8) Is the nucleon a dirac particle?.** Achtzehnter, J.; Wilets, L. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 8p. (CONF-8806130—7). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004571/JAW.

From Relativistic nuclear many-body physics conference; Columbus, OH, USA (6 Jun 1988).

A two-component Pauli equation for a composite model of the nucleon is derived using a relativistically covariant quark model. Results are presented as an expansion in the momentum and in derivatives for scalar-isoscalar, vector-isoscalar, vector-isovector and electromagnetic external potentials. The Dirac equation fails beginning with the magnetic moment and spin-orbit terms; the failure is modest for isoscalar potentials, but is large for the isovector case. For the vector fields we find anomalous "magnetic moments", which are simply related to the corresponding electromagnetic $\kappa$. Preliminary results involving the fields quadratically are also presented. 13 refs.

9865 **(DOE/ER/40427—22-N8) The nontopological soliton model.** Wilets, L. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 28p. (CONF-8805140—7). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004570/JAW.

From International conference on medium- and high-energy nuclear physics; Taipei, Taiwan (23 May 1988).

The nontopological soliton model introduced by Friedberg and Lee, and variations of it, provide a method for modeling QCD which can effectively include the dynamics of hadronic collisions as well as spectra. Absolute color confinement is effected by the assumed dielectric properties of the medium. A recently proposed version of the model is chirally invariant. 32 refs., 5 figs., 1 tab.

9866 **(DOE/ER/40427—23-N8) Electroweak physics and electron scattering.** Henley, E.M.; Hwang, W.Y.P. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 16p. (CONF-8805140—8). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004569/JAW.

From International conference on medium- and high-energy nuclear physics; Taipei, Taiwan (23 May 1988).

The electroweak theory is developed and applied to electron scattering from nucleons and light nuclei. It is shown that these scatterings can be used to test the standard theory and probe structure effects. 33 refs., 5 figs.

9867 **(DOE/ER/40427—26-N8) Fundamental aspects of nuclear physics.** Haxton, W.C. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1987. Contract FG06-88ER40427. 13p. (CONF-8708301—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004564/JAW.

From Symposium for D. Allan Bromley; New Haven, CT, USA (1 Aug 1987).

I am pleased to be able to attend this symposium in honor of D. Allan Bromley and to see the new accelerator of the Yale University Nuclear Structure Laboratory. My talk on symmetry tests seems appropriate for this occasion: so much of the progress in this field depends on detailed knowledge of nuclear structure. The nuclear "tricks" that are played to filter and amplify interactions are possible because the nuclear spectroscopists have cataloged nuclear levels and determined their properties. I will describe how such nuclear structure studies may help to provide a window on physics beyond the standard model. My talk is not a summary of this subfield of nuclear physics. There is simply too much happening today to make a summary talk feasible. Instead, I have chosen four topics that I hope are representative of the field as a whole: parity mixing of nuclear states, time-reversal-odd nuclear moments, the Mikheyev-Smirnov enhancement of solar neutrino oscillations, and a nuclear experiment to monitor the long-term rate of stellar collapse in the galaxy. 39 refs., 5 figs., 1 tab.

9868 **(INIS-BR—1374) Vertex of three and four gluons in the Yang-Mills theory.** Brandt, F.T.C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 105p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705170/JAW.

In a general covariant gauge, the structure of the three-point function with one and two external gluons on shell is studied. The contributions which result in the one-loop approximation are expressed in terms of simple functions containing collinear and soft singularities. Furthermore, the contributions asociated with the four-point vertex when all external gluons are on-sheel, are analysed. As an application of these results, the infrared structure of the gluon-gluon scattering amplitude, is studied.

9869 (INIS-SU—67/A, pp 33-35) **Subluminal longitudinal gluons in quark-gluon plasma.** Silin, V.P.; Ursov, V.N. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

It is shown, that polarization change of gluon spectrum results to the existance of longitudinal gluons with subluminal phase velocities. 7 refs.

9870 (INIS-SU—67/A, pp 36-38) **Chiral symmetry dynamical breaking in QCD and amplitude of soft $\pi$-meson scattering.** Maglaperidze, T.I.; Tkebuchava, F.G. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

S-wave amplitude of soft $\pi$-meson scattering was calculated in the frameworks of the mechanism of chiral symmetry dynamical breaking in QCD. The result is compared with $\pi\pi$-scattering amplitude, obtained from the phenomenological chiral Lagrangian. 9 refs.

9871 (INIS-SU—68, pp 490) **Strong decays of new exotic hadrons in the range of 1.5 GeV.** Muradov, R.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9872 **(INS—697) Dynamical model for excited weak gauge bosons.** Yasue, Masaki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756043/JAW.

Weak gauge bosons, W and Z, and their excited states, W* and Z*, are introduced through gauge fields and isotriplet matter fields of an SU(2)/sub L//sup loc/ x U(1)/sub Y//sup loc/ model, which are regarded as boundstates of scalar and spinor constituents carrying the weak-charges. Underlying dynamics of the form of nonlinear-interactions determines effective interactions for W* and Z*. On the basis of the induced lagrangian, phenomenological implications of the existence of W* and Z* are discussed.

9873 (JINR—R-15-87-288, pp 10-19) **Study on the K/sup +/ meson decay.** Litov, L.B. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780047/JAW. (CONF-8604409—).

From 3. seminar of young scientist of JINR in region of experimental physics; Dubna, USSR (1 Apr 1986).

Mechanisms of k/sup +/ meson decays by the following modes: K/sup +/ -> PI/sup +/PI/sup 0/PI/sup 0/, k/sup +/ -> PI/sup +/PI/sup 0/$\gamma$, k/sup +/ -> PI/sup +/e/sup +/E/sup -/ and k/sup +/ -> PI/sup +/$\gamma\gamma$, have been investigated. The staging of new experiments for the study of k/sup +/ meson decays, related not only to the testing by low-energy QCD but also to the possibility to clarify the dynamic mechanism of selection rule by isospin $\Delta T = 1/2$ and its violation, observaion of CP-noninvariant effects. 28 refs.; 4 figs.

9874 (JINR-D—9-87-105-Vol.1, pp 19-22) **Quantum chromodynamics: achievements and unresolved problems.** Ioffe, B.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780040/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

Modern status of quantum chromodynamics (QCD) is reviewed. Achievements of QCD: establishment of the form of QCD lagrangian, asymptotic freedom, noticeable progress in description of statical properties of mesons and baryons and low-energy processes based on chromodynamics, are reviewed. The unsolved problems: confinement, chiral symmetry, quarkonium, exotic states and hadron substance at high temperatures and densities are mentioned. 12 refs.

**9875 (LU-TP—87-8) How to detect colour field topologies in hadronic interactions.** Andersson, B.; Bengtsson, H.U. (Lund Univ. (SE). Dept of Theoretical Physics; Univ. of California, Los Angeles (US). Dept. of Physics). (Lund Univ. (Sweden). Dept. of Theoretical Physics). Jun 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755665/JAW.

We discuss the different colour field topologies of QCD interactions, and demonstrate how the existence of two different colour topologies in qg scattering will lead to an experimentally observable asymmetry in the production of K/sup +/K/sup -/ pairs in hadron-hadron collisions. (authors).

**9876 (LUNFD6/TFME—1015-1-8-1987) Parton showers in a phenomenological context.** Bengtsson, M. (Lund Univ. (Sweden). Dept. of Theoretical Physics). Aug 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755668/JAW.

Models for generating multiple parton final states, based on the Altarelli-Parisi equations, are presented. Algorithms are described for applications in e/sup +/e/sup -/ physics, leptoproduction and hadron physics. The two latter cases are somewhat special since composite objects are present in the initial state. Constraints from structure function evolution are properly taken into account. The scheme in leptoproduction is made selfconsistent in the sense that parton shower evolution does not affect the measurable structure functions. The scheme developed in e/sup +/e/sup -/ allows for a number of different features which are not given directly in this approach, i.e. matching onto matrix elements, coherence effects, argument in $\alpha$/sub s/, implementation of kinematics etc. These options are systematically studied, using Lund string fragmentation for hadronization, and compared with experimental data. A note on $\alpha$/sub s/ determinations in hadron-hadron collisions is also included.

**9877 (N—89-11498) Pseudo-scalar pi N coupling and relativistic proton-nucleus scattering.** Gross, F.; Maung, K.M.; Tjon, J.A.; Townsend, L.W.; Wallace, S.J. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1988. 12p. (NASA-TM—101199; NAS—1.15:101199; CEBAF-PR—88-010). NTIS, PC A03/MF A01.

Relativistic p-Ca-40 elastic scattering observables are calculated using relativistic NN amplitudes obtained from the solution of a two-body relativistic equation in which one particle is kept on its mass-shell. Results at 200 MeV are presented for two sets of NN amplitudes, one with pure pseudo-vector coupling for the pion and another with a 25 percent admixture of pseudo-scaling coupling. Both give a very good fit to the positive energy on-shell NN data. Differences between the predictions of these two models (which are shown to be due only to the differences in their corresponding negative energy amplitudes) provide a measure of the uncertainty in contructing Dirac optical potentials from NN amplitudes.

**9878 (SLAC-PUB—4749) Antiproton annihilation in quantum chromodynamics.** Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 55p. (CONF-8806292—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004970/JAW.

From International school of physics with low energy antiprotons: 3rd course on antiproton-nucleon and antiproton-nucleus interactions; Erice, Italy (10 Jun 1988).

Anti-proton annihilation has a number of important advantages as a probe of QCD in the low energy domain. Exclusive reaction in which complete annihilation of the valance quarks occur. There are a number of exclusive and inclusive {bar p} reactions in the intermediate momentum transfer domain which provide useful constraints on hadron wavefunctions or test novel features of QCD involving both perturbative and nonperturbative dynamics. Inclusive reactions involving antiprotons have the advantage that the parton distributions are well understood. In these lectures, I will particularly focus on lepton pair production {bar p}A $\rightarrow$ {ell}{bar {ell}}X as a means to understand specific nuclear features in QCD, including collision broadening, breakdown of the QCD "target length condition". Thus studies of low to moderate energy antiproton reactions with laboratory energies under 10 GeV could give further insights into the full structure of QCD. 112 refs., 40 figs.

**9879 Samuel replies.** Samuel, M. (Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078-0444). *Physical Review Letters;* **61**: No. 25, 2899-2899(19 Dec 1988).

"Through the use of a previous calculation of the light-by-light scattering contribution to the electron anamoly in sixth order, it is shown that theory and experiment disagree by 4 standard deviations." (AIP)

**9880 Two-photon-exchange force between charged systems: Spinless particles.** Feinberg, G.; Sucher, J. (Department of Physics, Columbia University, New York, New York 10027). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3763-3798(15 Dec 1988).

We use the methods of dispersion theory to extend to the case of two charged particles earlier studies of two-photon-exchange forces between neutral particles and between a neutral and a charged particle. The two-photon-exchange amplitude for two charged particles is infrared divergent but when we subtract the amplitude obtained by iteration of the one-photon-exchange potential, which is necessary to avoid double counting, this divergence is canceled. The difference amplitude, regarded as an analytic function of the invariant squared momentum transfer t has a discontinuity which is less singular than t/sup -1/ for small t. We are thereby led to a convergent expression for the fourth-order potential V/sup (4)/, given by the Laplace transform of this discontinuity. We give explicit gauge-invariant results for the long-range two-photon-exchange potential in the case of two spin-zero particles.

**9881 (JINR-D—1,2-86-668-Vol.1, pp 13-20) Effective meson lagrangians from QCD and skyrmions.** Andrianov, V.A.; Novozhilov, V.Yu. (Leningradskij Gosudarstvennyj Univ. (USSR)). 1987. NTIS (US Sales Only), PC A19/MF A01. Order Number DE89780026/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The main goal of this paper is to examine whether the effective lagrangian for pseudoscalar and scalar mesons deduced from QCD and its $\omega$-meson phenomenological modificatins generates locally stable skyrmion solutions. the fullfilled analysis shows that the low-energy realistic lagrangian of pseudoscalar and scalar mesons extracted from QCD does not reveal stable soliton solutions with baryon quantum numbers. The minimal phenomenological vector meson interaction stabilizes skyrmion through the obtained masses are two times higher than the nucleon mass. This fact demonstrates the uncompleteness of the QCD pseudoscalar and scalar sector only. The problem requires QCD inclusion of vector and pseudovector modes into the formation of skyrmion. 17 refs.; 1 tab.

**9882 e/sup +/-e/sup -/ hadronic multiplicity distributions: Negative binomial or poisson.** Carruthers, P.; Shih, C.C. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 653-660 of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

On the basis of fits to the multiplicity distributions for variable rapidity windows and the forward backward correlation for the 2 jet subset of e/sup +/e/sup -/ data it is impossible to distinguish between a global negative binomial and its generalization, the partially coherent distribution. It is suggested that intensity interferometry, especially the Bose-Einstein correlation, gives information which will discriminate among dynamical models.

## 6453 Particle Invariance Principles And Symmetries

*REFER ALSO TO CITATION(S) 9897, 9930, 9934, 9935, 9937, 9938, 10252*

**9883 (DOE/ER/40427—35-N8) Charge-symmetry breaking in the nucleon-nucleon system.** Williams, A.G. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 6p. (CONF-880983—18). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004577/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

The effects of charge-symmetry breaking on the two nucleon system are discussed. Two specific reactions are considered in detail: np elastic scattering and $np \rightarrow d\pi^0$, with some emphasis on the former. In np elastic scattering these effects have been calculated in terms of electromagnetic interactions and one-boson exchange (with other contributions estimated to be small), and are in reasonable agreement with the one existing measurement from TRIUMF. Calculations for $np \rightarrow d\pi^0$ are more difficult, but predict effects close to current experimental limits. 15 refs., 4 figs., 1 tab.

**9884 (IFT-P—25/88) Off critical point by perturbation: the Ising Model spin-spin correlator.** Dotsenko, V.S. (Landau Institute for Theoretical Physics, Moscow (USSR)). (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705080/JAW.

A kind of dimensional regularization is proposed in the conformal theory context in order to define the integrals of the perturbation in zeta~ (T-T/sub c/)/T/sub c/ series for correlation functions off critical point. Calculation is done for the second order term of the spin-spin correlation function in the Ising Model and is checked with the known result.

**9885 (IFT-TM—10/87) Applications of supersymmetry techniques.** Drigo Filho, E. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1987. 113p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705081/JAW.

Working in arbitrary dimension we generalize the harmonic oscillator and the Coulomb potentials and we study these systems using supersymmetric quantum mechanics. Then, in field theory we contruct BRST using a superfield treatment. We also study the relativistic particle without and with spin showing the supersymmetry of these systems.

**9886 (LU-TP—87-16) Twist and finite size effects for the source method.** Soederberg, B.; Loennblad, L. (Lund Univ. (Sweden). Dept. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755666/JAW.

We analyze the finite size effects for the source method in pure lattice gauge theory at weak coupling. They are found to be strongly suppressed by twisting the boundary conditions, for SU(3) by typically an order of magnitude. (authors).

**9887 (RRK—88-23) Possible central extension of the U(1) WZW model.** Soda, Jiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756086/JAW.

A possible central extension of the U (1) WZW model is studied. Its degenerate representations are found to be those of the Feigin-Fuchs systems. Supersymmetric version of this analysis is also performed. Although further extensions of our idea are possible, a naive central extension does not exist in the case of the non-abelian WZW model. Implications of this fact are briefly discussed.

**9888 Skyrmions.** Balachandran, A.P. (Syracuse Univ., Syracuse, NY (US)). pp 1-82 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

The article reviews the theory of chiral solitons and its applications to the description of baryons.

**9889 Aspects of the physics of strongly interacting w's and z's.** Gaillard, M.K. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp 404-430 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

The characteristic features of the standard Higgs sector are reviewed and extrapolated to the case where the Higgs mass exceeds a TeV. The results extracted are of more general validity than any specific model; they represent the minimal expectations for the first manifestation of phenomena associated with electroweak symmetry breaking that must occur at an energy scale not exceeding one or two TeV. A facility capable of detecting these phenomena is certain to provide experimental clues to the origin of electroweak symmetry breaking.

**9890 Fractional fermion number.** Niemi, A.J. (Institute for Advanced Study, Princeton, NJ (US)). pp 125-153 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

The authors explain the physics and mathematics of fermion number fractionization and review its topological index theory analysis. As applications the authors show how bosonic flux tubes are converted into elementary fermions in 2+1 dimensions, and analyze improved 3+1 dimensional chiral bag models for baryons.

**9891 Anomalies and topology.** Jackiw, R. (Massachusetts Institute of Technology, Cambridge, MA (US)). pp 83-124 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

The author lectures about topological effects in guage field theories, about fermionic chiral anomalies and about some relationships between them. The material has been described in many places so his emphasis is on recent insights. The necessary background is provided only sketchily.

## 6454 Field Theory

*REFER ALSO TO CITATION(S) 9743, 9880, 9889, 9890, 9891, 10303, 10335*

**9892 (BNL—42028) Lattice gauge theories and Monte Carlo algorithms.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1988. Contract AC02-76CH00016. 35p. (CONF-8806279—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003569/JAW.

From 14. GIFT international seminar on theoretical physics; Jaca, Spain (6 Jun 1988).

Lattice gauge theory has become the primary tool for non-perturbative calculations in quantum field theory. These lectures review some of the foundations of this subject. The first lecture reviews the basic definition of the theory in terms of invariant integrals over group elements on lattice bonds. The lattice represents an ultraviolet cutoff, and renormalization group arguments show how the bare coupling must be varied to obtain the continuum limit. Expansions in the inverse of the coupling constant demonstrate quark confinement in the strong coupling limit. The second lecture turns to numerical simulation, which has become an important approach to calculating hadronic properties. Here I discuss the basic algorithms for obtaining appropriately weighted gauge field configurations. The third lecture turns to algorithms for treating fermionic fields, which still require considerably more computer time than needed for purely bosonic simulations. Some particularly promising recent approaches are based on global accept-reject steps and should display a rather favorable dependence of computer time on the system volume. 34 refs.

9893 **(CBPF-MO—001/88) Introduction to strings and superstrings.** Traubenberg, M.R. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 122p. (In French). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88704998/JAW.

We discuss the main features on the formulation of string theory that, in a primitive level, describe the hadronic phenomenon of duality. We also study an extension of the models of closed and strings with spin. Then, by using supersymmetry, it is formulated the theory of superstrings and heterotic strings with the aim of unify the fundamental interactions and matter. (M.W.O.).

9894 **(CBPF-NF—006/88) Non-abelian gauge fields in the Poincare gauge.** Galvao, C.A.P.; Pimentel, B.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705000/JAW.

The canonical structure of non-Abelian gauge fields is analysed in the (non-covariant) Poincare gauge. General aspects of the gauge conditions and quantization prescriptions are discussed.

9895 **(CBPF-NF—024/88) Mellin transform technique for the heat kernel expansion.** Malbouisson, A.P.C.; Monteiro, M.A.R.; Simao, F.R.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705015/JAW.

It is shown, for a wide class of operators, that the solution to the associated heat equation may be obtained as a series. This is accomplished using the inverse Mellin transform of the Kernel of the s-th power of the operator, together with the analytic properties of the Kernel in the complex s-plane.

9896 **(DOE/ER/10587—1) Research in string theory and two dimensional conformal field theory: Progress report for period April 1, 1988--March 31, 1989.** Friedan, D.H.; Martinec, E.J.; Shenker, S.H. (Chicago Univ., IL (USA)). Dec 1988. Contract AC02-80ER10587. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005149/JAW.

The present contract supported work by Daniel H. Frieden, Emil J, Martinec and Stephen H. Shenker (principal investigators), Research Associates, and graduate students in theoretical physics at the University of Chicago. Research has been conducted in areas of string theory and two dimensional conformal and superconformal field theory. The ultimate objectives have been: to expose the fundamental structure of string theory so as to eventually make possible effective nonperturbative calculations and thus a comparison of sting theory with experiment, the complete classification of all two dimensional conformal and superconformal field theories thus giving a complete description of all classical ground states of string and of all possible two (and 1 + 1) dimensional critical phenomena, and the development of methods to describe, construct and solve two dimensional field theories. Work has also been done on skyrmion and strong interaction physics.

9897 **(DOE/ER/40153—5) Research in particle theory: Annual progress report, January 1, 1988--November 20, 1988.** Mansouri, F.; Suranyi, P.; Witten, L.; Wijewardhana, R. (Cincinnati Univ., OH (USA). Dept. of Physics). Nov 1988. Contract FG02-84ER40153. 33p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004330/JAW.

Heterotic parastrings in six and four space-time dimensions were constructed, which have gauge groups $E_8$ and spin $8/Z_2$, respectively. Parafermion theories of order Q in two dimensions were constructed and shown to be related to but not identical with fermion theories with an SO(Q) symmetry. Compactification schemes were studied in which $E_8$ {times} $E_8$ is a connection on a holomorphic vector bundle V, with the same Chern class as the tangent bundle, and the field equations were solved perturbatively. It was shown that supersymmetry could be maintained to second order. A particular family of solutions of Einstein's field equations with toroidal topology was found that contains Schwarzchild, Curzon, Back-Weyl, and gamma-metric solutions as special cases. Dynamical models of electro-weak symmetry breaking have been studied. Mechanisms for suppressing flavor changing neutral current amplitudes endemic to such models have been proposed. The impact of new interactions that appear at very high energies on spontaneous chiral symmetry breaking has been investigated. These interactions can enhance the chiral condensate and the Goldstone boson decay constant relative to the confinement scale leading to interesting phenomenology in technicolor models even below the weak interaction scale. The modular covariant partition functions were given in twisted sectors of conformal field theories with Z/sub n/ symmetries for theories with central charge $c = 1$ and $c < 1$. Bosonizable conformal energy tensors were investigated. The g/U(1)/sup r/ parafermionic theories of Fateev, Zamolodchikov and Gepner were bosonized. Additions of terms linear in a Kac-Moody algebra to the Virasoro algebra were shown to generate new conformal field theories with continuously changing central charge. 49 refs.

9898 **(DOE/ER/40423—10-P8) Open strings and boundary fermions.** Marcus, N. (Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract AS06-88ER40423. 18p. (CONF-8806293—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004573/JAW.

From Rome conference on string theory; Rome, Italy (6 Jun 1988).

This paper will be organized as follows: First I will give a general reminder of what open strings are. Next I will describe the introduction of Chan-Paton factors, and their rewriting as the quantum mechanics of fermions on the boundary of the world sheet. Then I will describe how these fermions can be used to construct sigma models describing non-abelian Yang-Mills fields, both in the bosonic and supersymmetric open string theories, and I will do some illustrative calculations in these sigma models. Finally I will end with a few conclusions. 23 refs., 7 figs.

9899 **(DOE/ER/40427—15-N8) Soliton bag models.** Wilets, L. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 15p. (CONF-8804125—3). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004572/JAW.

From Computational atomic and nuclear physics at one gigaflop conference; Oak Ridge, TN, USA (14 Apr 1988).

Soliton models are well-suited for dynamical calculations, such as hadron-hadron interactions and collisions, since for each variable in the Lagrangian the time derivative of that variable also appears. For such models, constrained (deformed) mean field solutions provide a basis for generator coordinate dynamical calculations. This requires the solution of a large number of coupled, nonlinear, differential equations involving the quark and scalar fields. The Henyey-Wilets method reduces the problem to the solution of a set of coupled, linear, inhomogeneous, differential equations to be iterated. In the chromodielectric model, color confinement is effected by the self and mutual interactios of the quarks through the chromelectric field. This requires the self-consistent calculation of the gluon propagator in a spatially varying dielectric function. This now involves the solution of a set of coupled, nonlinear integro-differential equations, which can be linearized and solved by iterations. The problem is computation intensive. 20 refs.

9900 **(IFUSP-P—690) On chiral bosonization.** Girotti, H.O.; Gomes, M.; Kurak, V.; Rivelles, V.O.; Silva, A.J. da. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705083/JAW.

We show that the Dirac braket quantization of a single self-dual field leads naturally to the bosonization formulas. We find a numerical parameter describing the soliton charge and unveiling hidden soliton sectors.

9901 **(IFUSP-P—691) On the operator solution of the Liouville theory.** Abdalla, E.; Santos, A.L. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705084/JAW.

Using quantized self dual fields, we present an explicit operator solution to the Liouville Theory, and discuss the results.

9902 **(IFUSP-P—692) Self dual fields and the Thirring model.** Gomes, M.; Kurak, V.; Rivelles, V.O.; Silva, A.J. da. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1987. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705085/JAW.

A recently proposed Lagrangean for self dual fields is used to analyse the Thirring model as a superposition of right and left moving fields. We show that the systematic construction of the Thirring field, based on the current algebra approach, follows from this Lagrangean and Dirac's theory for constrained systems.

9903 **(IFUSP-P—693) Bosonization methods in string theory.** Abdalla, E. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705086/JAW.

The use of bosonization/fermionization techniques to convert non-linear operators of the dual, is discussed. Non abelian bosonization to the case where the central charge of the Kac-Moody algebra is not unity, is generalized. In particular, using this generalization of non-abelian bosonization, the bosonic string vertex of the compactified theory; turns out to be fundamental field of thre fermionic theory, or bound states of it thus permiting explicit computations easily.

9904 **(IFUSP-P—694) Thirring strings: use of generalized non abelian bosonization techniques.** Abdalla, E. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1988. 39p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705087/JAW.

A discussion of compactified bosonic string theory is presented, with a thorough use of conformal invariance in order to relate the theory to the WZW model and U(n) invariant Thirring model at critical coupling. The quantization of these theories is discussed, as well as the definition of vertex operators in the various equivalent models above.

9905 **(IFUSP-P—711) Schwinger functions of a rational interaction: local existence of the Borel transform.** Costa, G.A.F.T. da; Gomes, M. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). May 1988. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705098/JAW.

We prove the local existence of the Borel transform of a two dimensional field theoretical model characterized by the rational interaction g/sup 2/x/sup 6//1+gx/sup 2/.

9906 **(IFUSP-P—715) Geometric phases and gravitational anomalies.** Caldas, P. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705100/JAW.

An analysis is made of the motion of a quantum particle in a gravitational field, and it is shown that a geometric phase arises under certain conditions. The connection of this results with the emergence of gravitational anomalies is described.

9907 **(IFUSP-P—716) Geometric phase of a quantum particle in a gravitational field.** Caldas, P. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Jun 1988. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705101/JAW.

A spinning particle in a gravitational field is shown to display a geometric phase. This provides a first-quantized example of a topological phase in a system with purely gravitational interactions. The connection with gravitational anomalies is briefly mentioned.

9908 **(INFN/AE—88-6) Toward solvable 4-dimensional conformal theories.** Furlan, P.; Petkova, V.B. (Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704907/JAW.

To be submitted to Mod. Pys. Lett. A.

The Symanzik representation, based on the Mellin transform, is explored to analyze the asymptotic behaviour of conformal invariant n-point functions, constructed through a generalization to arbitrary (even) space-time dimension of the two-dimensional Coulomb gas representation.

9909 **(INIS-BR—1352) Perturbation calculations with Wilson loop.** Peixoto Junior, L.B. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1984. 95p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705150/JAW.

We present perturbative calculations with the Wilson loop (WL). The dimensional regularization method is used with a special attention concerning to the problem of divergences in the WL expansion in second and fourth orders, in three and four dimensions. We show that the residue in the pole, in 4d, of the fourth order graphs contribution sum is important for the charge renormalization. We compute up to second order the exact expression of the WL, in three-dimensional gauge theories with topological mass as well as its assimptotic behaviour for small and large distances. the author.

9910 (INIS-SU—67/A, pp 12-13) **Ultraviolet-finite quantum electrodynamics.** Krasnikov, N.V.; Tavkhelidze, N.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

Ultraviolet-finite electrodynamics,containing the infinite number of massive vector fields with higher derivatives in interaction, was constructed. It was shown, that introduction of infinite-component vector field resulted to fundamentally new possibility of removing ultraviolet divergences in the quantum field theory in comparison with standard finite-component field theories of quantum chromodynamics type. 3 refs.

9911 (INIS-SU—67/A, pp 23-26) **Dispersion relations for scattering amplitudes, not satisfying the microcausality condition.** Fajnberg, V.Ya.; Lomsadze, Sh.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

Dispersion relations in nonlocalized theories with exponential amplitude growth in pulse space were obtained in the assumption, that they were analytical in twice cut plane with respect to variable energy and satisfied some additional conditions. 11 refs.

9912 (INIS-SU—67/A, pp 44-46) **Gauge-invariant formulation of stochastically quantized non-Abelian theory.** Gadzhiev, S.A.; Subbotin, A.V.; Fajnberg, V.Ya. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

Gauge-invariant formulation of stochastically quantized non-Abelian theory (in nonequilibrium phase), which is equivalent in certain calibration to Langevin equation with Zwanzigen member, is suggested. Ward identities, following from this symmetry, enable to prove gauge-invariant renormalization of non-Abelian stochastics. 11 refs.

9913 **(RRK—88-20) Quantum field theory of universe.** Hosoya, Akio; Morikawa, Masahiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756084/JAW.

As is well-known, the wave function of universe dictated by the Wheeler-DeWitt equation has a difficulty in its probabilistic interpretation. In order to overcome this difficulty, we explore a theoretical possibility of the second quantization of universe, following the same passage historically taken for the Klein-Gordon particles and the Nambu-Goto strings. It turns out that multiple production of universes is an inevitable consequence even if the initial state is nothing. The problematical interpretation of wave function of universe is circumvented by introducing an internal comoving model detector, which is an analogue of the DeWitt-Unruh detector in the quantum field theory in curved space-time.

**9914 (RRK—88-21) Notes on extended conformal algebras.** Sasaki, Ryu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1988. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756085/JAW.

Integer spin primary fields and their operator algebras with Energy-Momentum tensor in two dimensional bosonic conformal field theories (Feigin-Fuchs construction) are studied. A general method for calculating integer spin primary fields is given. It is shown that the generalization of the spin-3 algebra of Fateev and Zamolodchikov does not exist when the number of participating boson fields is greater than four. In a similar way higher spin ($s \geqq 4$) algebras are shown to be incompatible with a requirement of solvability.

**9915 (SLAC-PUB—4678) Light-cone quantized QCD in 1 + 1 dimensions.** Hornbostel, K.; Brodsky, S.J.; Pauli, H.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 21p. (CONF-8806130—6). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004967/JAW.

From Relativistic nuclear many-body physics conference; Columbus, OH, USA (6 Jun 1988).

The QCD light-cone Hamiltonian is diagonalized in a discrete momentum-space basis. The spectra and wavefunctions for various coupling constants, numbers of color, and baryon number are computed. 20 refs., 8 figs.

**9916 (SLAC-PUB—4688) New approach to high energy SU/sub 2L/ {times} $U_1$ radiative corrections.** Ward, B.F.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). Jul 1988. Contract AC03-76SF00515;AS05-76ER03956. 23p. (CONF-8805239—1; UTHEP—88-0801). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004964/JAW.

From 28. Cracow school of theoretical physics; Zakopane, Poland (31 May 1988).

We present a new approach to SU/sub 2L/ {times} $U_1$ radiative corrections at high energies. Our approach is based on the infrared summation methods of Yennie, Frautschi and Suura, taken together with the Weinberg-'t Hooft renormalization group equation. Specific processes which have been realized via explicit Monte Carlo algorithms are $e^+$ e/sup {minus}/ $\rightarrow$ f{bar f}' + n($\gamma$), f = $\mu$, {tau}, d, s, u, c, b or t and $e^+$ e/sup {minus}/ $\rightarrow$ $e^+$ e/sup {minus}/ + n($\gamma$), where n($\gamma$), denotes multiple photo emission on an event-by-event basis. Exemplary Monte Carlo data are presented. 16 refs., 4 figs.

**9917 (UCRL—99090-Rev.1) Loop-space general covariance in string field theory.** Klinkhamer, F.R. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 10p. (CONF-8805214—2-Rev.1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004810/JAW.

From Strings '88: superstring workshop; College Park, MD, USA (24 May 1988).

The prime goal in string physics today is to discover the underlying symmetries and derive the theory from first principles. Already a huge gauge symmetry was found in flat space-time background. Also, a progress report was given on an attempt by J. Greensite and myself to incorporate into bosonic string field theory a different invariance, namely loop-dependent general coordinate transformations. 15 refs.

**9918 (UCRL—99850) Properties of interacting cosmic string networks.** Bouchet, F.R.; Bennett, D.P. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1988. Contract W-7405-ENG-48. 27p. (CONF-8805224—2). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004779/JAW.

From Workshop on current status of cosmic strings; New Haven, CT, USA (5 May 1988).

We have studied by means of numerical simulations the dynamical evolution of a network of cosmic strings, in order to extract the main statistical properties of this system. Our basic conclusion is that scaling solutions exist, both in the radiation and matter era. In such a scaling solution the string energy density evolves as $t^{-2}$, which requires that the process by which long strings dump their energy into closed loops (which can gravitationally radiate away) is efficient enough to prevent the string domination over other forms of energy. On the other hand, the generated spectrum of loop sizes does depend on the value of our numerical lower cutoff (i.e., the minimum length of loop we allow to be chopped off the network). Still, it seems very likely that the network evolution is very different from the "standard model" in which a few horizon sized loops are created per horizon volume and per Hubble time (which subsequently fragment into about 10 smaller "daughter" loops). Rather, many tiny loops are directly cut from the network of infinite strings, and it appears that the only fundamental scale (the horizon) has been lost. This is probably because a fundamental ingredient had been overlooked, namely the kinks. These kinks are created in pairs at each intercommutation, and very rapidly, the long strings appear to be very "kinky". Thus the number of long strings per horizon is still of the order of a few, but their total length is fairly large. As far as the astrophysical consequences of our work are concerned, the most obvious implication stems from the increase in length per horizon volume of the infinite strings, which means that the infall of matter onto long string wakes will be enhanced, and might even dominate. We have also computed the two-point correlation function of the loops and confirm that, as in the work of Turok, loops are at birth correlated in much the same way as the Abell clusters. 22 refs., 10 figs.

**9919 (UWThPh—1988-21) Covariant virasoro operators and free bosonic string field theory.** Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705226/JAW.

A new formulation of the free bosonic gauge covariant string field theory is presented. The action functional as well as the gauge transformation laws are constructed generalizing a procedure given by Neveu and West. A new type of mathematical objects, called 'covariant Virasoro operators', is defined and used to cast the results into an extremely elegant form. 24 refs.

**9920 (UWThPh—1988-25) Group cocycles, line bundles, and anomalies.** Blau, M. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705229/JAW.

The relation between complex line bundles and certain group cocycles is explored in general to obtain explicit formulae for the transition functions and curvature of the determinant line bundle DET of a family of Dirac operators coupled to Yang-Mills fields. A covariant derivative on sections of DET is constructed which realizes the curvature and 'minimally couples' to the integrated anomaly which thus appears as a 'functional magnetic field' on gauge orbit space. The transcription of group cohomological (cocycles) into geometrical (line bundles) information is refined in such a way that the relevant cohomology groups can be computed in many cases, giving insight into the classification of lifts of principal group actions. 23 refs.

**9921 (UWThPh—1988-26) QCD sum rules: selected topics.** Bertlmann, R.A. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705230/JAW.

We review the field of QCD sum rules with emphasis of some recent developments. 61 refs., 2 figs., 2 tabs.

**9922 (UWThPh—1988-34) Bogolubov group and quantization of scalar fields.** Bombelli, L.; Wyrozumski, T. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 23p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705236/JAW.

We present an approach to the Bogolubov group for a Klein-Gordon field on a curved background, based on the structure of the space of solutions of the field equation and on a simple notation which makes the structure available more transparent than in usual approaches. This suggests a modified formalism for quantizing

fields on a curved background. Creation and annihilation operators are replaced by a single, 'universal' object, from which observables may be constructed by means of certain projectors giving the appropriate creation and annihilation parts. The problem of defining vacua and particles is then reduced to the dynamics of these projectors, based on the Bogolubov group. We then apply this approach to calculations of particle creation rates using a known general, abstract prescription for associating vacua to spacelike hypersurfaces. Finally, we conclude with some remarks on the implementation of the adiabatic approximation method in our approach and on a new geometrical framework for quantization on a curved background. 13 refs.

9923 **Rotational anomaly and fractional spin in the gauged $CP^1$ nonlinear $\sigma$ model with the Chern-Simons term.** Panigrahi, P.K.; Roy, S.; Scherer, W. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **61**: No. 25, 2827-2830(19 Dec 1988).

We consider the interacting $CP^1$ nonlinear $\sigma$ model in 2+1 dimensions in the presence of an Abelian Chern-Simons term and quantize it canonically using the Dirac-Bergmann algorithm. There arises an anomalous term in the angular momentum in presence of the interaction, which in the long-range limit yields the fractional spin for the excitations.

9924 **Adiabatic methods in the functional Schroedinger picture.** Lieberman, B.; Rogers, B. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3648-3656(15 Dec 1988).

A prescription is given to specify the high-k behavior for the Gaussian width of a Schroedinger wave functional for a scalar field in a Robertson-Walker flat background. The prescription corresponds to a construction which produces nearly Minkowski behavior for the high-frequency modes, and is analogous to the well-known "adiabatic method" previously developed in the canonical formalism. The specified high-k behavior leads to divergences in <T/sub $\mu$//sub $\nu$/> which agree with the poles appearing in the DeWitt-Schwinger expansion of this quantity.

9925 **Improvement of the derivative expansion.** Chan, L. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3739-3746(15 Dec 1988).

We propose an algebraic method to improve the convergence of the derivative expansion. This method, originally designed to improve the convergence of the derivative expansion of the two-dimensional phi$^4$ field theory, can easily be adopted for field theory in any dimension. While this method may appear to be far from mathematically rigorous and unique, and the example seems to be unrealistic, it opens up the possibility that a clever technique with proper analytic continuation can turn the derivative expansion into a useful tool in studying effective low-energy phenomenology.

9926 **Wilson loops in the fermion—non-Abelian-vortex system.** Bezerra de Mello, E.R. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3755-3762(15 Dec 1988).

We obtain the behavior of the Wilson loop, under certain approximations, in the fermion—non-Abelian-vortex system defined in (2+1)-dimensional space-time. Our procedure consists of the restriction to the J = 0 channel for the quantum fluctuation around the vortex sector and s component for the fermionic wave function. We analyze the Wilson loops for the case of massless fermions and massive ones when $m << e^2$. Finally, we study the Wilson loops in the absence of fermions.

9927 **Conformal deformation by the currents of affine g.** Freericks, J.K.; Halpern, M.B. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Annals of Physics (New York);* **188**: No. 2, 258-306(Dec 1988).

We develop a quasi-systematic approach to continuous parameters in conformal and superconformal field theory. The formulation unifies continuous twists, ghosts, and mechanisms of spontaneous breakdown in a general hierarchy of conformal deformations about a given theory by its own currents. Highlights include continuously twisted Sugawara and coset constructions, generalized ghosts, classes of N = 1 and 2 superconformal field theories with continuous central charge, vertex-operators for arbitrarily deformed lattices, operator-valued conformal weights and/or central charages, and generalizations of continuous SO(p,q) families of conformal field theories. copyright 1988 Academic Press, Inc.

9928 **Supersymmetry transformations in the operator formulation of string field theory.** Jevicki, A.; Sazdovic, B. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Annals of Physics (New York);* **188**: No. 2, 347-385(Dec 1988).

We present an explicit construction of supersymmetry generators in the operator formulation of open string field theory. Witten's open string theory is considered with the associated Neveu-Schwarz and Ramond sectors. A precise formulation of NS-R string overlaps and their construction in the Hilbert space is given. The connection with the fermion emission vertex is established. copyright 1988 Academic Press, Inc.

9929 **Symplectic geometry of strings.** Niemi, A.J. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Annals of Physics (New York);* **187**: No. 2, 369-448(1 Nov 1988).

A coordinate independent, canonical formulation of bosonic strings is discussed using symplectic geometry on a graded phase space. In particular, it is shown that the BRST invariance, and more generally the Osp(1, 1 chemical bond 2) invariance, of a string is coordinate independent. Polarization dependence of the quantum theory, as well as the emergence of the critical dimension related to polarization nonpreserving canonical transformations, is investigated. Gauge invariant and gauge fixed aspects of Osp(1, 1 chemical bond 2)] cohomology are clarified and the existence of a new type of anomaly, appearing in the gauge fixing, is established. Using nonunitary canonical transformations nilpotent gauge invariant BRST operators are constructed in all dimensions and for all values of intercept. Functional integral formulation of the pertinent world-sheet field theory is free of local Lorentz anomalies, with the lapse and shift fields appearing as dynamical degrees of freedom instead of the Liouville field as in the Polyakov approach. copyright 1988 Academic Press, Inc.

9930 **Comparison of update algorithms for pure Gauge SU(3).** Gupta, R.; Kilcup, G.W.; Patel, A.; Sharpe, S.R.; Deforcrand, P. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM (US)). *Modern Physics Letters B;* **3**: No. 14, 1367-1378(Oct 1988).

The authors show that the overrelaxed algorithm of Creutz and of Brown and Woch is the optimal local update algorithm for simulation of pure gauge SU(3). The authors' comparison criterion includes computer efficiency and decorrelation times. They also investigate the rate of decorrelation for the Hybrid Monte Carlo algorithm.

9931 **Is the f$_\xi$(1590) the O/sup ++/ scalar glueball.** Slaughter, M.D. (Mail Stop B283, Medium Energy Physics Div., Los Alamos National Lab., Los Alamos, NM (US)). *Modern Physics Letters B;* **3**: No. 14, 1361-1366(Oct 1988).

In a nonperturbative, algebraic approach to QCD, the author presents arguments which strongly indicate that the f/sub o/(1590) is not the 0/sup ++/ scalar glueball. Specifically, the author computes the branching ratio quantities BR(G→eta eta')/Br(G→KK-bar)/BR(G→eta eta), and BR(G→$\pi$/sup 0/$\pi$/sup 0//BR(G→eta eta) as functions of only one coupling ratio r = <G vertical bar A/sub $\pi$/- vertical bar $\pi$/sup +/> vertical bar <G vertical bar A/sub K/sup -// vertical bar K/sup +/>, where G = pure or physical scalar glueball, and demonstrate that for no value of r are the experimental data for f/sub 0/ (1590) obtained.

**9932** (JINR-D—1,2-86-668-Vol.1, pp 78-88) **Rotational and vibrational states in SU(2) Skyrme model.** Nikolaev, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A19/MF A01. Order Number DE89780026/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

To caculate the properties of nucleon and its excitations the Skyrme-Vitten ansatz is used. SU(2) quantization of the Skyrme model, quantum numbers, spin and isospin are considered. A collective variable of skyrmeon monopole vibrations is introduced. The mass spectrum of nonstrange dibaryons and mean square distribution radii of the baryon charge is calculated, as well as electric charge density. The application of Skyrme-Votten ansatz and kphi ansatz brings about dibaryon states with greatly differing masses. kphi ansatz results in rotational bands in the calculated dibaryon mass spectrum with assigned isospin. The decline and position of rotation bands are largerly determined by account of vibrational freedom degrees. 6 refs.; 2 figs.

**9933** **The origin of KNO scaling violation in the parton branching model.** Sarcevic, I. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM (US)). pp 639-644 of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

The authors present multiplicity distributions in the parton branching model. They obtain a new non-scaling law for the probability distribution. In the high energy limit scaling is approached from below in agreement with experimental data.

**9934** **An introduction to the theory of strings.** Peskin, M.E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US)). pp 217-273 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

These lectures present, from an introductory perspective, some basic aspects of the quantum theory of strings. They treat (1) the kinematics, spectrum, and scattering amplitude of the bosonic string, (2) the spectrum and supersymmetry of Green-Schwarz superstring, and (3) the identification of the underlying gauge invariances of the string theory.

**9935** **Group theory for string states.** Ramond, P. (Univ. of Florida, Gainesville, FL (US)). pp 274-323 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

String theories have recently attracted considerable interest since they offer a possibility of unifying gravity and matter within the framework of quantum mechanics, in a way which may not be inconsistent with low energy data. In 26 space-time dimensions there is only one type of string theory describing open and closed purely bosonic strings with or without a gauge group of the type SO(n) or Sp(2n), added a la Chan-Paton. This theory contains in its spectrum a tachyon (negative mass squared state). In 10 space-time dimensions, there are five string theories which describe both bosons and fermions, linking them via supersymmetry. Only one of these describes open and closed strings with only SO(32) as an allowed gauge group. All others describe closed strings. Two are of the heterotic type, necessarily containing SO(32) or E/sub 8/ x E/sub 8/ as gauge groups. The other two contain no gauge groups have two supersymmetries, and allow for vector-like or chiral fermions respectively.

**9936** **Topological methods in field theory.** Alvarez, O. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp 154-216 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

These lectures cover several topics in the application of topological and geometrical methods to problems in elementary particle physics. The lectures are supposed to elucidate the concepts and are intended to be neither mathematically rigorous nor comprehensive. They are supposed to give the reader a flavor of the use of topological and differential geometric methods in quantum field theory. The lectures begin with a review of elementary differential geometry. Differential forms are used to prove the Gauss-Bonnet theorem; the simplest of the theorems that relate curvature with the topology of the manifold. A cursory introduction to vector bundles and the index theorem is given followed by a "proof" of the index theorem in flat space. Along the way the relation of the U(1) anomaly with the index theorem is discussed. A brief introduction to string theory is given with emphasis on the geometry. The lectures end with a calculation of the celebrated critical dimensionality of 26.

**9937** **Axions...The search continues.** Krauss, L.M. (Yale Univ., New Haven, CT (US)). pp 431-470 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

Axion physics relates to the following areas discussed at the Theoretical Advanced Study Institute: 1. Topology; 2. Anomalies; 3. Current Algebra, Chiral Lagrangians; 4. Effective Lagrangians; 5. Dark Matter; 6. Inflation, Early Universe; 7. "String" Theories; 8. New Physics at Collider Energies-Technicolor; 9. Rare Kaon Decays; 10. Experimental Probes of High Energy Physics. In the course of this paper, the authors review axion physics, from its origins in theory, to the prospects for detection. In doing this, he demonstrates, using axions as an example, how particle physics manages to turn seemingly obscure mathematical formalism into the stuff from which experiments are born.

**9938** **Theoretical expectations at collider energies.** Eichten, E. (Fermi National Accelerator Lab., Batavia, IL (US)). pp 709-972 of High energy physics 1985. Volumes 1 and 2. Bowick, M.J.; Gursey, F. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506240—).

From Theoretical advanced study institute on elementary particle physics; New Haven, CT, USA (9 Jun 1985).

This series of seven lectures is intended to provide an introduction to the physics of hadron-hadron colliders from the Spbarp to the SSC. Applications in perturbative QCD [SU(3)] and electroweak theory [SU((2) circle times U(1)] are reviewed. The theoretical motivations for expecting new physics at (or below) the TeV energy scale are presented. The basic theoretical ideas and their experimental implications are discussed for each of three possible types of new physics: (1) New strong interactions (e.g. Technicolor), (2) Composite models for quarks and/or leptons, and (3) Supersymmetry (SUSY).

# 65 PHYSICS II

*REFER ALSO TO CITATION(S) 9633*

**9939** **(INIS-SU—43) Experimental and theoretical physics. Collection.** Basov, N.G. (ed.). (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 65p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780030/JAW.

This collection contains reports of research in solid state physics, astrophysics, nuclear physics, and accelerator technology. Separate abstracts have been prepared for each paper.

**9940** **(INIS-SU—63) Physics of radiation injuries and radiation materials technology. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Gematologii i Perelivaniya Krovi, Moscow (USSR)). 1988. 104p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauk i Tekhniki.; No. 2(44).
Separate abstracts were prepared for the individual papers in this report.

9941 **(INIS-SU—67/A) Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1988. 50p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.
Kratkie Soobshcheniya po Fizike.; No. 5.
Separate abstracts were prepared for the papers in this collection.

9942 **(KDK—97) Progress report on nuclear data activities in Sweden for 1986.** Conde, H.; Ramstroem, E. (Uppsala Univ. (SE). Dept. on Neutron Research; Uppsala Univ. (SE). The Studsvik Neutron Research Lab.). (Swedish Nuclear Data Committee, Stockholm). Aug 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755664/JAW.
This report contains information from laboratories in Sweden about measurements and compilations which are relevant to obtain nuclear data for research and development in different applied fields of nuclear physics. The report also contains short information about developments of experimental techniques in applied nuclear physics as well as changes of existing or new experimental equipments. The document contains information of a preliminary or private nature and should be used with discretion. Its contents may not be quoted without the explicit permission of the originator. (authors).

## 6510 Nuclear Physics

*REFER ALSO TO CITATION(S) 8802, 9853, 10030, 10032, 10568*

9943 **(BARC—1417) Report of the Nuclear Physics Division (January 1, 1987 to December 31, 1987).** Rao, K.R.P.M.; Chakrabarty, D.R. (eds.) (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 134p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88704997/JAW.
Nuclear Physics Division is involved in research in nuclear and solid state physics. The year 1987 has been a fairly eventful one for the Division in the sense that several activities came to a high level of fruition. A beam of 5/sup +/ silicon ions accelerated to about 14 MeV in the BARC-TIFR Pelletron accelerator was obtained for the first time in September. Experiments on the cyclotron at Calcutta and the CN Van-de-Graaff accelerator at Trombay have continued. The latter continued to be heavily utilised for nuclear, chemical, materials and other applications in its twentysixth year of operation. For the neutron scattering programme at Dhruva Reactor two new diffractometers were commissioned, one of a conventional type and another based on a metre long position sensitive detectors (PSD). A neutron interferrometer was successfully operated at the CIRUS reactor. A modular CW argon laser giving a total power of about 2.7 watts has been incorporated with the Raman scattering spectrometer thus increasing the range of performable experiments. The modularity allows quick replacement of parts. A number of interesting investigations were carried out by the members of the Division; among others they include observations of quasi-molecular heavy ion resonances in Sisup(2s), anomalous behaviour of deep sub-barrier fission in uranium, crystalline to amorphous to crystalline transition in tetracyanoethylene, exceptional stability of the quasi-crystal Al/sub 6/CuMg/sub 4/ and the development of a phenomenological mode to describe magnetisation curves in the new high-Tsub(c) superconductors. These and many other investigations are reported. (M.G.B.).

9944 **(CBPF-NF—023/88) Cross section of ternary fission of Al, Ti, Co and Zr nuclei induced by 0,8 - 1,8 Gev photons.** Lima, D.A. de; Sousa, E.V. de; Milomen, W.C.C.; Tavares, O.A.P. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705014/JAW.
A research on ternary fission of Al, Ti, Co, and Zr nuclei induced by bremsstrahlung photons of 0,8, 1,0, 1,4, and 1,8 Gev end-point energies has been carried out using makrofol polycarbonate and CR-39 polymer as fission-track detectors. Results are discussed and compared with other ternary fission data. (M.W.O.).

9945 **(DOE/ER/03624—1) [Nuclear Structure Research] at the Triangle Universities Nuclear Laboratory: Annual report No. 27, 1 September 1987--31 August 1988.** (Duke Univ., Durham, NC (USA); North Carolina Univ., Chapel Hill (USA); North Carolina State Univ., Raleigh (USA)). 1988. Contract AS05-76ER03624;FG05-88ER40442;AC05-76ER01067;FG05-88ER40441. 138p. NTIS, PC A07/MF A01 - OSTI. Order Number DE89004865/JAW.
This report contains papers in the following topics: Fundamental symmetries in the nucleus; Dynamics of few-nucleon systems; Tensor forces in light nuclei; nucleon-nucleus interactions mechanisms; Nuclear structure and reactions; and Development and instrumentation. (LSP)

9946 **(DOE/ER/40147—6) Nuclear interactions of high energy heavy ions and applications in astrophysics: Technical progress report, 1 April 1988--31 March 1989.** Wefel, J.P. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 14 Dec 1988. Contract FG05-84ER40147. 34p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004940/JAW.
During the past year of activity under DOE Grant DE-FG05-84ER40147 at Louisiana State University we have made significant progress in the data analysis, in hardware development for the Bevalac and in new experimental runs. We now have reliable longitudinal momentum distributions for $^{16}O$ at three energies, 225, 170 and 360 MeV/nucleon. Combining these results with previous data shows an unexpected energy dependence of the momentum widths for A = 12--15 fragments. The widths peak at {approximately}100 MeV/nucleon projectile energy. We have also finished the analysis for 3 of the 4 energy points from the 6/87 $^{28}Si$ investigation of the total charge changing cross sections. These results also show an energy dependence. With the University of Siegen group, we have analyzed the test data from a new drift chamber system and used the system to provide trajectory measurements for the $^{28}Si$ run in B40. The test data demonstrated position resolution of better than 100μm in some operating modes, and a study of the resolution dependence on timing mode, discriminator setting and wire voltage has been prepared for publication. The $^{28}Si$ run provided 30-50% of the data we had hoped to obtain. There were significant beam and beamline tuning problems at our rigidity. Nevertheless, a relatively complete dataset for 245 MeV/n $^{28}Si$ was obtained, processed and calibrations are in progress. In addition, we have participated in a HISS run at 2.1 GeV/n obtaining data on the fragmentation of $^{4}He$ and $^{20}Ne$. All of the datasets, both B40 and HISS, are being analyzed and significant progress has been achieved. 20 figs.

9947 **(GSI—88-16(ed.4)) EDAS-manual. SATAN - system to analyze tremendous amounts of nuclear data. Vol. 2. Commands, macros, and procedures.** Goeringer, H.; Gralla, S.; Malzacher, P.; Richter, M.; Schall, D.; Winkelmann, K. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Sep 1988. 438p. NTIS (US Sales Only), PC A19/MF A01. Order Number DE88756183/JAW.
The system to analyze tremendous amounts of nuclear data (SATAN) shows different steps of a special experiment data evaluation called 'Linearisation'. The report contains the EDAS-manual with EDAS-command, TSO-command, macro and procedure. Syntax and usage of EDAS macros are explained.

9948 **(HMI-B—449) HMI Section of Nuclear and Radiation Physics - annual report 1987.** (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik). 1988. 222p. (In German, English). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755950/JAW.

This annual report contains extended abstracts of the scientific work performed at the named institute together with a list of publications and talks. The scientific work is concerned with the theory of nuclear and atomic processes with heavy ions, the experimental study of heavy ion reactions, nuclear structure studies, nuclear solid-state physics, atomic collisions, and the operation of VICKSI. (HSI).

9949 **(INIS-BR—1385) Heavy ion pre-buncher for the USP pelletron.** Pessoa, E.F.; Douglas, R.A.; Sala, O. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Feb 1986. 43p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705180/JAW.

We outline the main features of two types of boosters for tandem accelerators: the double drift and the single gap (gridded) harmonic bunchers, for use in the USP Pelletron. (M.W.O.).

9950 (INIS-SU—66, pp 65-75) **Massive heavy-ion reactions.** Khojzenga, D.R.; Batler, M.A.; Rozner, Kh.; Vajl, I.L.; Datta, S.S.; Suza, R.T.; Khil'sher, D.; Shreder, V.U.; Toke, J. (Rochester Univ., NY (USA). Nuclear Structure Research Lab.). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

Selected topics associated with massive heavy-ion reactions are described. Included are discussions of energy dissipation and equilibration of fragments in damped reactions, angular distributions of fragments in fusion-fission reactions, and intermediate-type reactions with partial relaxation of the mass-symmetry degree of freedom. 16 refs.; 9 figs.; 2 tabs.

9951 (JINR—R-15-87-288, pp 20-27) **Search for exotic nuclei in nature using laser spectroscopy methods.** Gradechny, Ch.; Zemlyanoj, S.G.; Myshinskij, G.V. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780047/JAW. (CONF-8604409—).

From 3. seminar of young scientist of JINR in region of experimental physics; Dubna, USSR (1 Apr 1986).

New experiments are suggested to search for exotic nuclei in natural samples of the Earth crust using the methods of laser spectroscopy. The experiments suggested will help to solve the following problems: the determination of solar neutrino fluxes; search for superheavy element fission products; search for exotic nuclei, to which superdense and strange nuclei are referred, as well as nuclei, which comprise a heavy X-particle with the mass of 10/sup 2/ - 10/sup 5/ GeV/c/sup 2/; determination of cosmic ray flux variations. The sequence of the experiment staging and methods to cope with the background radiation are discussed. 10 refs.; 2 figs.; 1 tab.

## 6511 Experimental Techniques

9952 **(AD-A—197074/8/XAB) Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1987.** Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). 31 Jan 1988. 35p. NTIS, PC A03/MF A01.

This project concerns the demonstration of the feasibility of the tuning and perhaps even stimulation of nuclear radiation. Theory has indicated that anti-Stokes Raman unconversion of intense but conventional long-wavelength sources of radiation produced by scattering from isomeric states of nuclear excitation could lead to significant sources of tunable gamma radiation characterized by the natural Moessbauer widths of the lines. This would result in lines with sub-Angstrom wavelengths and widths of a few MHz. Whether or not these processes can reach threshold depends upon the resolution of basic issues lying in an interdisciplinary region between quantum electronics and nuclear physics that have not been previously addressed. It was the purpose of this work to study these issues experimentally.

9953 **(AD-A—197333/8/XAB) Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser. Quarterly report, 1 January-31 March 1988.** Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). Apr 1988. 91p. (GRL—8704). NTIS, PC A05/MF A01.

Recent approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long-wavelength radiation. At the nuclear level the storage of energy approaches teraJoules per liter for thousands of years. This report focuses upon the nuclear analog of the optical double-resonance method which produced much of the data base at the molecular level that was of such essential use in the development of conventional lasers. Applied most recently to the study of levels which might be used in dumping isomeric populations into freely radiating states, it produced an unexpected result of major importance. In several test isotopes, a class of extremely useful states was discovered that could radiatively couple to both normal and isomeric states of a nucleus spanning large changes of angular momentum. Demonstrated was the excitation of populations of the second of the 29 actual candidates for a gamma-ray laser. Another of the less attractive of the 29 isomers because of a large change in angular momentum of 5 h, 123Te superscript m was one of the few which had both a radioactive signature sufficiently distinctive for detection and a stable ground state from which to fabricate a target.

9954 **(KURRI-TR—303) Proceedings of the 4th specialist research meeting on measurements of short-lived isotopes.** Yoshizawa, Yasukazu; Kawase, Yoichi; Okano, Kotoyuki (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Apr 1988. 58p. (In Japanese). (CONF-8801127—). NTIS (US Sales Only), PC A04/MF A01 - OSTI. Order Number DE89003364/JAW.

From 4. specialist research meeting on measurements of short-lived isotopes; Kyoto, Japan (12 Jan 1988).

The specialist research meeting at KURRI started in 1984 to exchange information and discuss various problems associated with experimental techniques for the study of short-lived nuclei. Recent developments on ISOL systems in Japan, measuring techniques for radiation, theoretical study of a gross theory and the international cooperative study for high spin states were reported and discussed. These valuable contributions to the meeting are collected in these Proceedings. We hope that the Proceedings are valuable for those who have interests in the field of experiments on short-lived nuclei. Thirteen papers have been indexed separately.

## 6512 Nuclear Properties And Reactions, A=1-5, Experimental

9955 **(DOE/ER/40444—1) Nuclear structure and reaction studies at medium energies: Progress report, April 1988-March 1989.** Hoffmann, G.W.; Ray, R.L.; Barlett, M.L.; Pauletta, G. (Texas Univ., Austin (USA). Dept. of Physics). Dec 1988. Contract FG05-88ER40444. 102p. NTIS, PC A06/MF A01 - OSTI. Order Number DE89005064/JAW.

This document constitutes the (1988--1989) progress report for the ongoing medium energy nuclear physics research programs supported by The US Department of Energy through special research grant DE-FG05-88ER40444. A major part of the work has been associated with research done at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) using the High Resolution Spectrometer (HRS), the External Proton Beam (EPB), and the new Neutron Time of Flight Facility (NTOF). Other research has been done at the Fermi National Accelerator Laboratory (FNAL). The research effort focuses on: providing proton + nucleus data which test nonrelativistic and relativistic models of the medium energy proton + nucleus interaction, providing (p,p') and (p,n) data which are to be analyzed to provide new nuclear structure information (both ground state and excited state), providing nucleon + nucleon data to aid in the systematic study of the fundamental nucleon-nucleon interaction, developing and improving the proton + nucleus theoretical models themselves, and initiating new experimental programs whose goals are to search for new phenomena in nuclear physics.

9956 (INIS-SU—68, pp 345) **Study on the four-particle nuclear reactions in kinematically total experiment.** Zerkin, V.V.; Konfederatenko, V.I.; Lashchenov, B.V.; Pilipchenko, V.A.; Povoroznik, O.M.; Struzhko, B.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9957 **(JINR-R—1-87-523) Determination of topological cross sections of inelastic d-bard interactions at 12 GeV/c momentum.** Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88704935/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The topological cross sections, mean multiplicity and dispersion in inelastic d-bard-interactions at 12 GeV/c on a sample of {similar←to} 10000 events are determined. The cross sections corresponding to the difference between topological cross sections of the inelastic d-bard- and dd-interactions are determined. The obtained experimental characteristics are compared with the behaviour of the N-barN-interactions at energies in the neighbourhood of 6.1 GeV. 19 refs.; 2 figs.; 6 tabs.

9958 **(LUIP—8705) (/sup 3/He,t) and (d,/sup 2/He)reactions at intermediate energies.** Brockstedt, A. (Lund Univ. (Sweden). Dept. of Physics). Sep 1987. 61p. (LUNFD6-NFFK—7081-1-112-1987). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755667/JAW.

The (/sup 3/He,t) reaction has been studied at 0.6-2.3 GeV at small scattering angles, 0-7 degrees, on various nuclei (/sup 12/C, /sup 13/C, /sup 26/Mg, /sup 40/Ca, /sup 48/Ca, /sup 54/Fe, /sup 90/Zr, /sup 159/Tb, /sup 208/Pb) including a proton target. The reaction is a single-step reaction and selects the spin-isospin channel. Angular distributions for low-lying states in /sup 12/N are well described by DWIA calculations. From /sup 13/C to /sup 13/N transitions the ratio J/sub $\sigma$tau//J/sub tau/, at momentum transfer, q, close to zero, is derived. The ratio remains roughly constant in the region 300 - 700 MeV/nucleon. The position of the quasi-free peak is shifted compared with free nucleon-nucleon scattering. The shift is towards higher excitation energies at q approx 1.4 fm/sup -1/, and towards lower excitation energies at q approx 2.5 fm/sup -1/. The p(/sup 3/He,t)$\Delta$/sup ++/ reaction is analysed as one-pion exchange and the (/sup 3/He,t) form factor is extracted. The shape and position of the $\Delta$ resonance seem to be independent of target mass for the targets studied. Compared with the p to $\Delta$/sup ++/ transition the position is shifted towards lower excitation energy in nuclei. The (d,2p[/sup 1/S/sub 0/]) reaction, with the two protons in an /sup 1/S/sub 0/ state labelled /sup 2/He, is studied at 0.65 and 2.0 GeV at small angles, 0-4 degrees, on some of the targets used in the (/sup 3/He,t) experiment (p, /sup 12/C, /sup 40/Ca, /sup 54/Fe). This reaction is also a one-step reaction that can be used for studies of spin-isospin excitations. Cross sections and tensor analysing powers are determined for the p(d,/sup 2/He)n reaction. These results are compared with PWIA calculations. The $\Delta$ resonance in carbon is also here shifted down in excitation energy compared with the proton target.

## 6513 Nuclear Properties And Reactions, A=6-19, Experimental

9959 **(DOE/ER/40342—1) [Studies of nuclear reaction at very low energies]: Technical progress report.** Cecil, F.E. (Colorado School of Mines, Golden (USA). Dept. of Physics). 14 Dec 1988. Contract FG02-87ER40342. 55p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89005032/JAW.

We summarize the accomplishments of the first full year's operation of the Colorado School of Mines low energy nuclear physics project utilizing the General Ionex Model 1545 low energy, high current particle accelerator. The projects which we have completed which were explicity included in the original contract proposal include the measurement of the gamma ray branching ratios of the p + $^{6}$Li, p + $^{7}$Li, and p + $^{11}$B reactions as well as the absolute yield of the reaction $^{9}$Be(p,$\gamma$)$^{10}$B between proton laboratory energies of about 40 to 180 keV. in the course of these measurements we have demonstrated the associated gamma ray technique for Germanium detector efficiency calibration at gamma ray energies up to 12 MeV using very low energy proton beams. We have, in addition, pursued a fairly comprehensive investigation of an extremely interesting and totally surprising phenomenon in which we see a yield of the d-d fusion reaction during bombardment of deuterated polyethylene by light to medium ion and molecular beams which is greatly enhanced over the yield expected from a straightforward secondary ion reaction calculation. This enhanced yield is seen to correlate with the beam line pressure, suggesting target heating effects to be the source of the enhancement. In conjunction with a parallel contract with the Applied Plasma Physics Program in the DOE Office of Fusion Energy, we have developed an eight channel fast gamma ray spectrometer utilizing the fluorocarbon liquid scintillator NE226. The system has been operated at total gamma ray count rates up to 2.5 MHz with good energy resolution and with no measured dead-time and acceptable levels of pulse pile-up.

## 6514 Nuclear Properties And Reactions, A=20-38, Experimental

9960 **(FRCEA-TH—86) Production and de-excitation modes of hot nuclei formed in the reactions /sup 84/Kr + /sup 12/C, /sup 84/Kr + /sup 27/Al, /sup 84/Kr + /sup Nat/Ti at 26.4, 34.4 and 45.4 MeV/nucleon.** Faure-Ramstein, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie; Paris-11 Univ., 91 - Orsay (France)). Jan 1988. 171p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756134/JAW.

Formation and de-excitation of hot nuclei at intermediate energies was studied, using inverse kinematics to measure the characteristics of fragments of mass > 10 atomic units produced in the reactions Kr + C, Al and Ti at 25, 35 and 45 MeV/u. Spectrum analysis of the velocity and distributions of complex fragments (mass <40u) shows an emission component from a source in equilibrium, well reproduced by Monte Carlo simulations, except for Kr + Al and Ti at 45.4 MeV. For Kr + C at 25 and 35 Mev/u, this emission component corresponds to complete fusion, which represents only a tenth of the cross section of evaporation residues. In the other cases, pulse transfer is incomplete. The emission of complex fragments therefore separates out the hottest nuclei formed in the reaction. Source velocities associated with evaporation residues and fragments decrease as the system becomes more symmetrical. Maximum excitation energies calculated assuming mass transfer increase as a function of available energy, and reach 5.8 MeV/u for available energy equal to bond energy. A statistical de-excitation model which includes complex fragment emission qualitatively reproduces these results, assuming an angular momentum of the emitting nucleus of 40 to 50 Planck constant for all the systems. The excitation energy remains < 4.2 MeV/nucleon, i.e., lower than in the mass transfer hypothesis.

9961 **(INIS-mf—11843) Study of the neutron exit channel of 3He-induced nuclear reactions in view on the projectile-breakup mechanism.** Kaminsky, A. (Hamburg Univ. (Germany, F.R.). Fachbereich Physik). 27 Jan 1987. 214p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755953/JAW.

The scope of this work is to study the systematic behaviour of the neutron exit channel in /sup 3/He-induced break-up reactions with /sup 27/Al, /sup 63/Cu, /sup 93/Nb and /sup 197/Au for projectile energies of 26.0, 34.4 and 43.1 MeV both, experimentally and with theoretical predictions in terms of DWBA-calculations. Inclusive neutron spectra were measured for laboratory emission angles from 3/sup 0/ to 177/sup 0/ using the time-of-flight facility of the Hamburg isochronous cyclotron with its eight 4"diameter x 2"-Ne213 neutron scintillation detectors and flight paths of (7.50+-0.50)m. The compound and precompound contributions to

the inclusive cross sections were separated by normalizing Ewing-Weisskopf resp. hybrid model calculations to the data in regions where these mechanisms dominate and then subtract them incoherently. The remaining component is assigned to direct reaction mechanisms, especially the projectile break-up. It shows that characteristic broad continuous bump with a maximum located approximately at one third of the incident energy. However, this maximum is shifted to lower or higher energies in neutron- and proton-spectra, respectively. The energy shift increases with the target proton number. Additional individual properties of the target nucleus seem to be less important for the reaction mechanism. Consideration of energy shifts in the experimental data as well as a partial wave expansion in the framework of the DWBA-theory indicate that the main contribution to the reaction cross section originates from a peripheral region of the nucleus with about 10% of the central nuclear density. The angular distributions are forward peaked hence showing another characteristic of direct nuclear reactions. The anisotropic behaviour increases with the emission energy but is only slightly dependent on the entrance channel. About 50% of the break-up yield is emitted into the cone between 0/sup 0/ and 30/sup 0/. (orig./HSI).

## 6515 Nuclear Properties And Reactions, A=39-58, Experimental

9962 (INIS-SU—68, pp 384) **Inclusive spectra and angular distributions of α-particles emitted in the /sup 58/Ni + /sup 16/O reaction at E(/sup 16/O)=73 MeV.** Antropov, A.E.; Kudoyarov, M.F.; Pasternak, A.A.; Pugovkin, A.P.; Rassadin, L.A.; Smirnov, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9963 (IPEN-PUB—192) **Study of thermal neutron capture in /sup 58/ Ni.** Carbonari, A.W.; Pecequilo, B.R.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 20p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705201/JAW.

The energies and intensities of the primary gamma-rays from /sup 58/Ni (n, γ)/sup 59/Ni reaction have been measured with a Ge(li) pair-spectrometer in the region of 3.7 to 9.3 MeV. The thermal neutron capture cross section of /sup 58/Ni was determined to be 4.52 +- 0.10 by summing the primary transition intensities. The neutron separation energy was found to be 8999.93 +- 0.34 KeV. It is shown that the decay of the capture state is non-statistical and that there is a strong correlation between the strengths of excitation of levels by the (n, γ) and (d,p) reactions. These results are discussed in terms of a direct neutron capture reaction mechanism.

9964 (LYCEN-T—8727) **Neutrons emission study in the /sup 20/Ne + /sup 165/Ho and /sup 20/Ne + /sup 58/Ni reactions at 30 MeV per nucleon.** Cheynis, B. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1987. 168p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756263/JAW.

The neutrons emission in the /sup 20/Ne + /sup 165/Ho and /sup 20/Ne + /sup 58/Ni reactions at 30 MeV per nucleon is analyzed in terms of emitter source. A particular attention is given at a source with a speed near half that those of incidental beam at a 8 MeV temperature. A comparative study of low and high energy models describing this source reveals the similitudes between the two approaches.

## 6516 Nuclear Properties And Reactions, A=59-89, Experimental

9965 (ANL/NDM—107) **An evaluated neutronic data file for elemental cobalt.** Guenther, P.; Lawson, R.; Meadows, J.; Sugimoto, M.; Smith, A.; Smith, D.; Howerton, R. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 54p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89005019/JAW.

A comprehensive evaluated neutronic data file for elemental cobalt is described. The experimental data base, the calculational methods, the evaluation techniques and judgments, and the physical content are outlined. The file contains: neutron total and scattering cross sections and associated properties, (n,2n) and (n,3n) processes, neutron radiative capture processes, charged-particle-emission processes, and photon-production processes. The file extends from 10/sup {minus}5/ eV to 20 MeV, and is presented in the ENDF/B-VI format. Detailed attention is given to the uncertainties and correlations associated with the prominent neutron-induced processes. The numerical contents of the file have been transmitted to the National Nuclear Data Center, Brookhaven National Laboratory. 143 refs., 16 figs., 5 tabs.

9966 (GANIL-P—88-02) **β-delayed neutron emission of /sup 15/B, /sup 18/C, /sup 19/N, /sup 20/N, /sup 34/Al, /sup 35/Al and /sup 39/P.** Mueller, A.C.; Bazin, D.; Schmidt-Ott, W.C.; Anne, R.; Guerreau, D.; Guillemaud-Mueller, D.; Saint-Laurent, M.G.; Borrel, V.; Jacmart, J.C.; Pougheon, F. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756153/JAW.

The isotopes /sup 15/B, /sup 18/C, /sup 19/N, /sup 20/N, /sup 34/Al, /sup 35/Al and /sup 39/P have been produced as projectile-like fragments from the interaction of a /sup 86/Kr beam of 45 MeV/u from GANIL with a /sup 181/Ta target. Separated by the 0/sup 0/ magnetic analyser LISE, the nuclei are identified by means of a ΔE - E semiconductor telescope. It is surrounded, in a geometry close to 4π, by a thin plastic scintillator (NE 102) and a large volume liquid scintillator (NE 213) for the detection of betas and neutrons, respectively, from the decay of the implanted nuclei. By observation of the β-delayed neutrons, the half-lives T/sub 1/2/ and neutron emission probabilities P/sub n/ have been measured. The T/sub 1/2/ of /sup 18/C, /sup 20/N, /sup 35/Al, /sup 39/P and P/sub n/ of /sup 18/C, /sup 19/N, /sup 20/N, /sup 34/Al, /sup 35/Al and /sup 39/P are determined for the first time. For the isotopes /sup 17/C, /sup 36/Si, /sup 37/Si and /sup 38/P upper limits of P/sub n/ are deduced.

9967 (INIS-mf—11852) **βand γ spectroscopy on neutron rich nuclides of the chromium-nickel region.** Bosch, U. (Goettingen Univ. (Germany, F.R.). Fachbereich Physik). 24 Apr 1987. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755959/JAW.

The aim of the present thesis is to obtain new informations about neutron-rich nuclei. It is reported about the identification of the new isotopes /sup 58,59/Cr, /sup 63/Mn, /sup 66,67/Co, about indications of a new isotope at the mass 60, and new decay properties of the isotopes /sup 58/Mn (3.0 s), /sup 60m/Mn, /sup 65/Co, and /sup 69/Ni. (orig./HSI).

9968 **Neutron capture by /sup 79/Br, /sup 81/Br, and /sup 75/As.** Macklin, R.L. (Oak Ridge National Lab., P.O. Box X, Building 6010, Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **99**: No. 2, 133-144(Jun 1988).

Neutron capture up to 700 keV was measured for arsenic and bromine and for an enriched sample of /sup 81/Br. Individual resonance capture was parameterized in the first several kilo-electron-volts and average capture cross sections derived at the higher energies. Maxwellian average cross sections found for /sup 79,81/Br and /sup 75/As, respectively, were 741 =- 30, 244 +- 10, and 455 +- 18 mb for a temperature kT = 30 keV. Resonance capture integrals calculated for /sup 79.81/Br, respectively, were 130 +- 5 and 46.6 +- 1.8 b.

## 6517 Nuclear Properties And Reactions, A=90-149, Experimental

9969 **(GSI—88-14) Study of the reaction dynamics of dissipative heavy ion reactions by a kinematical coincidence apparature and γ circular polarimeters.** Schandera, C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Muenchen Univ. (Germany, F.R.)). Jul 1988. 198p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755943/JAW.

The reaction dynamics of dissipative heavy ion reactions is studied by measurement of the circular polarization of the γ radiation which is emitted by the highly excited reaction products. The object of these measurements were the systems /sup 86/Kr+/sup 139/La and /sup 86/Kr+/sup 166/Er at incident energies of 705 MeG and 860 MeV. The experiments were performed at the heavy ion accelerator UNILAC of the GSI. From the measured γ circular polarizations the spin polarizations of the reaction fragments in direction of the scattering norm were obtained. (orig./HSI).

9970 (INIS-SU—68, pp 232) **Magnetic dipole and electric quadrupole moments of the isomer 6/sup +/, 2480 keV in /sup 110/Sn.** Volkov, D.A.; Gorbachev, B.I.; Kovalenko, A.I.; Levon, A.I.; Nemets, O.F.; Sevastyuk, O.V.; Shevchuk, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9971 (INIS-SU—68, pp 233) **Anomalies in internal conversion coefficients of E2-transitions in /sup 122m/Sb.** Vishnevskij, I.N.; Zheltonozhskij, V.A.; Ukhin, M.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9972 (INIS-SU—68, pp 234) **Excitation of /sup 115m/In during irradiation of thick indium targets by positrons.** Borozenets, G.P.; Vishnevskij, I.N.; Zheltonozhskij, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9973 (INIS-SU—68, pp 237) **Precise measurements of line intensities ratios of internal conversion electron spectrum of the /sup 125/Te 109.27 keV M4-transition.** Davidonis, R.Yu.; Zhirgulyavichyus, R.K.; Kalinauskas, R.A.; Makaryunas, K.V.; Steponavichyus, S.I.; Tamolyunas, J.J. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9974 **(ISN—88-07) Hot nuclei production and deexcitation in heavy ions induced reactions on medium mass targets in the 10-84 MeV/nucleon energy domain.** Lleres, A. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jan 1988. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756256/JAW.

Velocity, angular distributions and total cross sections for heavy residues produced in the reactions /sup 12/C, /sup 14/N, /sup 20/Ne, /sup 40/Ar + /sup 124/Sn have been measured in the 10-84 MeV/nucleon incident energy range using catchers technique in association with off-line gamma-activity spectroscopy. The observed reaction products are interpreted as evaporation residues from equilibrated systems formed by complete or incomplete fusion of the projectile and target nuclei. From the velocities and residual masses measured at forward angles, the linear momentum transfers and excitation energies associated with the intermediate systems are estimated using simple fusion-evaporation models and are next compared to the predictions of the preequilibrium and Fermi jets models. Energy, angular, charge and charge correlation distributions for intermediate mass fragments emitted in the reaction /sup 32/S + /sup nat/Ag at 30 MeV/nucleon were also measured using gaseous and silicon detectors. The energy and angular distributions indicate that both equilibrated and non-equilibrated emitting sources are present. The equilibrium emission is attributed to the deexcitation of systems produced by incomplete fusion of the projectile and target nuclei. The charge correlation distributions are consistent with an asymmetric fission decay process. The linear momentum transfer and excitation energy associated with the equilibrated source are estimated using a simple fusion-fission model.

9975 **(LYCEN-T—8745) Peripheral collisions study in the /sup 22/Ne + /sup 93/Nb interactions at 30 MeV per nucleon.** Chbihi, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Sep 1987. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756265/JAW.

The study of the /sup 22/Ne + /sup 93/Nb system at 30 MeV per nucleon gives evidence to a competition of different mechanisms according to theoretical predictions. Transfer reaction, fragmentation and even more relaxed reaction have been observed from inclusive measurements analysis. A comparison with the /sup 20/Ne + /sup 93/Nb reaction at 30 MeV per nucleon underlines the influence of the projectile nuclear structure on some fragments production yields. The enhancement of the /sup 23/Na channel in /sup 22/Ne induced reaction is explained from the fact that the projectile is neutron rich, enabling the pick-up of one proton to the target. Cold break-up and sequential break-up can be differentiated from exclusive measurements: - In a cold break-up the primary ejectile is produced at a very small excitation energy (Q-opt) and breaks-up in two pieces leading to fragment - α particle or fragment - fragment correlations. - Sequential break-up i.e. emission of light particules from a very excited primary ejectile. A simulation of that mechanism using the code LILITA well reproduces output channels such as Nitrogen, Boron and Carbon. The overproduction observed for these fragments comes from the fact that the sequential break-up is favored. The study of the partition of excitation energy between target-like and projectile-like primary fragments clearly demonstrates that the excitation generated in these peripheral reactions is associated with the transfer of mass.

9976 **(NAC-RR—663) Half-life of /sup 125/I.** Simpson, B.R.S.; Meyer, B.R. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). Sep 1988. 15p. the CSIR, National Accelerator Centre, P O Box 72, Faure, 7131, South Africa.

The half-life of /sup 125/I has been measured as 59.40 +- 0.05 days. The activity, which was followed over a period of 93 days, was measured using a direct method. The half-life measurement confirms the most recently reported value which indicated that the accepted value of 60.0 +- 0.1 days was probably incorrect.

## 6518 Nuclear Properties And Reactions, A=150-189, Experimental

9977 **(CONF-880896—5) Experimental studies of quasi-fission reactions.** Back, B.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003968/JAW.

From Symposium on heavy-ion reaction dynamics in tandem energy region; Hitachi, Japan (1 Aug 1988).

A large number of recent experimental studies have shown that a substantial fraction of the total reaction cross section in heavy-ion reactions is found in fission-like processes, which do not result from the fission decay of a completely fused system. Following the suggestion of Swiatecki such processes, which represents a complete relaxation of the relative kinetic energy and a substantial amount of net mass transfer between the two fragments, are denoted quasi-fission reactions. They are distinct from compound fission reactions by bypassing the stage of a completely fused-system. This typically means that they are associated with short reaction times, which results in several measurable characteristics such as broken forward-backward symmetries, large anisotropies of the angular distributions and increased widths of the fragment mass distributions.

The distinction between quasi-fission and deep inelastic reactions is less stringent and has the character of a gradual evolution from one reaction type to the other, as found also as quasi-elastic reaction evolves into deeply inelastic processes as a function of the total kinetic energy loss. In the present paper some of the experimental data characterizing quasi-fission reactions are reviewed and discussed. 22 refs., 6 figs.

9978 **(DOE/ER/40402—1) Oregon State University nuclear chemistry progress report, July 1, 1987--August 1, 1988.** Loveland, W.D. (Oregon State Univ., Corvallis (USA)). Aug 1988. Contract FG06-88ER40402. 48p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004714/JAW.

The work described herein is part of a project involving the study of intermediate energy (10-100 MeV/A), and relativistic (>250 MeV/A) heavy ion reactions. In our studies of intermediate energy nuclear collisions, we are excited about the initial success during the past year in describing the properties of the heavy residues from these collisions. Using a VUU formalism, we were able, for the first time, to account for the yields, angular distributions and energy spectra of these target-like participants in the reactions. We experimentally characterized, in two different studies, a fast, non-equilibrium fission process in intermediate energy collisions involving $^{32}S$ and $^{40}Ar$ projectiles. The process has many of the characteristics of "fast fission" or "quasi fission" but occurs with a probability that is 2-3 X that expected for these processes. Heavy residue production in these collisions was shown also to involve direct non-equilibrium processes. The concept of total projectile kinetic energy scaling for relativistic nuclear collisions was investigated experimentally and with computer simulations. Unusual instances of the validity of this scaling were found and insight was obtained as to why and where this concept could be valid. A series of further investigations to characterize the previous finding of preferential backward emission of intermediate mass fragments ("backsplash") in ultrarelativistic reactions were launched with several experiments being done. Finally, work was begun on the construction of a heavy residue spectrometer for use in heavy ion storage rings such as CELSIUS. These developments, while in their infancy or gestation period, are expected to form the basis for more sophisticated, exclusive measurements in future years.

9979 **(INIS-BR—1363) Studies of the giant resonances in heavy nuclei.** Cataldi, M.I.C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 118p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705159/JAW.

Experimental measurements of the eletrodisintegration cross section in /sup 181/Ta, /sup 208/Pb and /sup 209/Bi nuclei are made in the Linear Accelerator of the IFUSP-Brazil. The cross section is obtained by the direct counting of the emitted neutrons, in an electron excitation energy range between 8 to 22 MeV. The experimental data are analysed throught the virtual photon method, with the aim of obtaining the isoscalar and isovectorial electric quadrupole giant resonance (E2GR) intensities, as well as the magnetic dipole intensity. For each studied nucleus the results obtained for the E2GR, isoscalar and isovectorial, are compared with the photodisintegration cross section measured by the Saclay and Livermore laboratories. From this comparison, it is observed that the photodisintegration cross sections are compatibles with the existence of an isovector E2GR, located between 120 to 130 A/sup -1/3/ Mev and which exhaust around 100% of the Energy-Weighted Sum rules (EWSR). (L.C.).

9980 (INIS-SU—68, pp 125-126) **Study on the /sup 183/W in the (n,n'γ) reaction.** Bejtin'sh, M.R.; Prokof'ev, P.T. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9981 **(IPNO-T—88-03) Laser spectroscopy of neutron deficient gold and platinum isotopes.** Savard, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Mar 1988. 118p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756255/JAW.

A new method for on-line laser spectroscopy of radioactive atoms based on the resonant ionization spectroscopy of laser-desorbed radioactive samples has been devised. An experimental setup has been installed on-line at the ISOCELE mass separator in Orsay (France) and experiments have been performed on the region of transitional nuclei around Z=79. Isotopic shift measurements on four new isotopes /sup 194/Au, /sup 196/Au, /sup 198/Au, /sup 199/Au have been performed on gold and results on the neutron deficient isotopes down to /sup 186/ Au have been obtained confirming the nuclear ground-state shape transition from oblate to prolate between /sup 187/Au and /sup 186/Au. The first isotopic shift measurements on radioactive platinum isotopes have been obtained on /sup 186/Pt, /sup 188/Pt, /sup 189/Pt. Indications of a shape transition have been observed between /sup 186/Pt and /sup 188/Pt. The extracted experimental changes in mean square charge radii δ < tau/sup 2/ > /sup A,A'/ along isotopic chains are compared to self-consistent Hartree-Fock plus BCS calculations.

9982 **(LPCC-T—87-04) Gamma ray multiplicity study associated at fast fission in Ne + Re at 220 MeV and Ar + Ho at 315 MeV collisions.** Martin, V. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire). Nov 1987. 68p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756262/JAW.

Angular momentum transfer to fission fragments has been studied with the measurement of gamma-ray deexcitation in the 220 MeV Ne + Re and 315 MeV Ar + Ho systems. These reactions lead to the same fusion nucleus with the same excitation energy. The critical angular momentum for fission in the Ne + Re system is close to the angular momentum where the fission barrier of the fusion nucleus vanishes. In the Ar + Ho system, the critical angular momentum is much more larger than the angular momentum and the fast fission process is then expected to occur in that system. The measurement of the widths of the fission fragment mass distribution strengthens this hypothesis: the width is equal to 42 +- 2 u.m.a in the Ne + Re system and 56 +- 4 u.m.a in the Ar + Ho system. The results obtained by measuring the gamma-ray multiplicity associated with the fission modes show that the spin transferred to the fragments is large and confirm the excitation of some collective rotational modes in the exit channel such as bending and wriggling modes. The evolution of the gamma-ray multiplicity as a function of the total kinetic energy shows a marked behaviour in the two systems: in the Ne + Re system, the multiplicity decreases when the kinetic energy increases in the Ar + Ho system the multiplicity increases when the kinetic energy increases. The information extracted from these results show that the mass distribution associated with the fast fission process has a symetric shape, but this information is not sufficient to isolate unambiguously the partial wave domain associated with the conventional fission and the fast fission phenomena, respectively.

9983 **Nuclear Data Sheets for A = 179.** Browne, E. (Lawrence Berkeley Laboratory, Berkeley, California 94720, USA). *Nuclear Data Sheets;* **55**: No. 4, 483-582(Dec 1988).

Spectroscopic data for all nuclei with mass number A = 179 have been evaluated, and the corresponding level schemes from radioactive decay and reaction studies are presented. This evaluation for A = 179 supersedes the earlier one by E. A. Henry (76He03), published in Nuclear Data Sheets 17, 287 (1976).

9984 **Nuclear Data Sheets for A = 186.** Firestone, R.B. (Lawrence Berkeley Laboratory, Berkeley, California 94720, USA). *Nuclear Data Sheets;* **55**: No. 4, 583-664(Dec 1988).

Spectroscopic data for all nuclei with mass number A = 186 have been evaluated, and the corresponding level schemes from radioactive decay and reaction studies are presented. A new decay scheme has been proposed for /sup 186/Tl ε decay (27.5 s), and an unobserved E3 isomeric transition from the 2—(2.0 h) isomer in /sup 186/Ir is suggested. Also, a previously proposed isomer in /sup 186/Au with T/sub 1/2/<2 min has been disproven by 83Po10. Outstanding problems in A = 186 include the excitation of the (8+) 2.0 x $10^5$ y isomer in /sup 186/Re. High-spin levels are not only poorly known in /sup 186/Re and it is proposed that /sup

186/W(d,2nγ) reaction studies would be valuable towards resolving this question.

## 6519 Nuclear Properties And Reactions, A=190-219, Experimental

9985 **(GSI—88-13) Study of /sup 40/Ar induced peripheral heavy ion collisions at 30 MeV pro nucleon.** Eckert, E.M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.)). Jul 1988. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755942/JAW.

In the framework of the present thesis with the reactions / sup 40/Ar+Th and /sup 40/Ar+Au at 30 MeV/nucleon studies on the reaction mechanisms in peripheral collisions in the intermediate energy range were performed. Peripheral reactions were selected since a heavy projectile fragment with Z ≧12 was detected. From the opening angle of the two fission fragments the linear momentum transfer to the target nucleus was determined. The fission probability for thorium and gold was determined in dependence on the charge number of the projectile fragment. For thorium the fission probability amounts in the mean to 50% and varies only weakly with Z/sub proj/. For gold the value for Z/sub proj/ ≧16 lies near zero and increases with decreasing projectile rest to 30%. Furthermore the angular momentum transfer in the primary reaction was determined by means of the linear momentum transfer. The angular momentum at time of the fission was determined by the measured anisotropy of the fission fragments and the fission probability. The angular momentum transfer increases with decreasing projectile fragment and reaches in the primary reaction for Z=12 about 50-60 Planck constant while it amounts in the secondary reaction independently on projectile fragment for thorium to ≃20 Planck constant and for gold to ≃30 Planck constant. (orig./HSI).

9986 **(GSI—88-15) Complex fragment emission in the reaction /sup 197/Au -> /sup 197/Au at an incident energy of 15 MeV/u.** Schmoll, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Fachbereich Chemie). Jul 1988. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755944/JAW.

For the study of the dominant decay processes in the reaction 15 MeV/u /sup 197/Au -> /sup 197/Au in one-particle inclusive experiments the emission characteristics of all ejectiles in the mass range 24 ≦A ≦197 were studied. The deflection function of the projectile-like fragments is for all energy losses at the grazing angle Θsub cm//sup gr/=27.5 degrees peaked and in fact even for scattering events in which the whole available kinetic energy was dissipated in the collisions. The systematic analysis of the velocity spectra shows that the lightest fragments are formed in double-sequential fission of the highly excited gold-like fragments from the first deep inelastic reaction stage before reaching of a global equilibrium. On the other side symmetrical fission products, which are part of the narrow branch of the mass distribution, are emitted in simple-sequential non-equilibrium fission. This simple-sequential breakup is very closely limited to excitation energies of 75 ≦E/sup */ ≦275 MeV of the primary, gold-like fragments, while the probability for double-sequential fission above E/sup */ ≃200 MeV increases very strongly. Contrarily to equilibrated compound-nucleus fission these processes are characterized by a in the source system strongly anisotropic angular distribution with distinct foreward/backward asymmetry and by an extremely asymmetric mass split. The study of the mass distribution shows that non-equilibrium fission at 15 MeV/u is both in view of the reaction cross section and regarding the creation of the complex fragments is the dominant decay process. The integral cross section of the broad four-body distribution corresponds to 60% of the total reaction cross section; the integral cross section of the narrow three-body distribution corresponds to 10%. (orig./HSI).

9987 (INIS-SU—68, pp 235) **On the decay of /sup 193m/Ir through electron bridge.** Vishnevskij, I.N.; Zheltonozhskij, V.A.; Kolomiets, V.M.; Muzalev, P.N.; Ukhin, M.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9988 **Nuclear Data Sheets for A = 214.** Akovali, Y.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6371, USA). *Nuclear Data Sheets;* **55**: No. 4, 665-711(Dec 1988).

The available nuclear structure information for all nuclei with mass number A = 214 is presented. Various decay and reaction data are evaluated and compared. Adopted data, levels, spin and parities are given.

## 6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

9989 **(CONF-880546—41) Measurement of the $^{235}$U(n,f) reaction from thermal to 1 keV.** Schrack, R.A. (National Bureau of Standards, Washington, DC (USA)). 1988. Contract AI01-86ER40275. 4p. NTIS, PC A02 - OSTI. Order Number DE89004819/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The neutron induced fission cross section for $^{235}$U has been measured from .02 to 1000 electron volts at the NBS electron LINAC facility. This cross section, especially the integrals from 7.8 to 11 eV and from 100 to 1000 eV, is incorporating both the $^{235}$U foils and the $^{10}$B foils used to monitor the neutron beam was built. The geometry of the chamber and the data taking system are designed to give the effect of a common environment and flight path so as to reduce or eliminate background and energy assignment problems. The shape measurements were normalized at thermal. Results are compared to other recent measurements and ENDF/B-V. 5 refs., 9 figs., 3 tabs.

9990 **(CONF-880546—42) Measurements of the $^{235}$U(n,f) standard cross section at the National Bureau of Standards.** Johnson, R.G.; Carlson, A.D.; Wasson, O.A.; Duvall, K.C.; Behrens, J.W.; Meier, M.M.; Patrick, B.D.; Dias, M.S. (National Bureau of Standards, Washington, DC (USA)). 1988. Contract AI01-86ER40275;W-7405-ENG-36. 4p. NTIS, PC A02 - OSTI. Order Number DE89004817/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

The primary mission of the Neutron Interactions and Dosimetry Group at the National Bureau of Standards (NBS) is the measurement of the standard neutron cross sections. The group has had a long-term program for the measurement of one of the most important of these cross sections---the neutron-induced fission cross section of $^{235}$U. Since the ENDF/B-VI evaluation has been recently released, it is appropriate to review the measurements of the $^{235}$U(n,f) cross section which have been made at the NBS using accelerator-based neutron sources. In the 0.1--20 MeV region where this cross section is a standard, six separate measurements of the differential cross section, using a variety of techniques have been made. Both the NBS 150-MeV Electron Linac and the 3-MV Positive Ion Accelerator have been used as neutron sources. Two of the measurements are relative to the H(n,p) cross section while the remainder are absolute. These measurements will be reviewed and compared to ENDF/B-VI. The current status of this program and possible future improvements will be discussed. 11 refs., 3 figs., 1 tab.

9991 (INIS-SU—66, pp 3-13) **New achievements in nuclear fission physics.** Khasse, R.V. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Nuclear constants. Scientific-technical collection.

A few recently observed new effects in nuclear fission are reviewed from the experimental side and theoretical explanations are indicated: 1) The structures in the mass yields and in the maximum fragment kinetic energies in cold fission are due to Coulomb effects; 2) Mass-symmetric fission of even-even nuclei does not proceed by splitting the nucleus into two equal parts and the fragments are differently deformed; 3) The dip in the total fragment kinetic energy at symmetry is due to a different symmetrical fission barrier; 4) In analogy to the cold compact fission events with highest kinetic energy, also those events of lowest kinetic energy but highest deformation are cold at the scission point; 5) Cold fission proceeds close to the saddle point. 33 refs.; 13 figs.; 2 tabs.

9992 (INIS-SU—66, pp 14-23) **Energy dissipation in descent from saddle to scission in fission at low excitation energies.** Gennenvajn, F. (Tuebingen Univ. (Germany, F.R.). Physikalisches Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Nuclear constants. Scientific-technical collection.

Nuclear charge measurements of fragments in thermal neutron fission of actinides ranging from Th to Cf are reviewed. The proton odd-even effect of the fragments is evaluated to yield information on the energy dissipated in the course of fission between the saddle and the scission point. The dissipated energies found are rather small. They vary smoothly with Z/sup 2//A of the compound nucleus and increses from 3 MeV for /sup 230/Th up to 11 MeV for /sup 250/Cf. 31 refs.; 7 figs.

9993 (INIS-SU—66, pp 24-33) **Experimental investigation of nuclear fission dynamics.** Gusev, Yu.I.; Seliverstov, D.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Nuclear constants. Scientific-technical collection.

The experimental results obtained during the last years in the multiparameter investigations of triple fission at low excitation energies are reviewed. The trajectory calculations performed on the basis of these data are analysed with the aim of extracting an information on dynamic conditions in the moment of nuclear scission. The results of calculations are compared with various theoretical approaches to the description of fission process and first of all the prescission kinetic energy of fission fragments. 29 refs.; 16 figs.; 2 tabs.

9994 (INIS-SU—66, pp 33-44) **On formation of mass-energy distributions of fragments in fission of cold nuclei lighter than radium.** Itkis, M.G.; Okolovich, V.N.; Smirenkin, G.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Nuclear constants. Scientific-technical collection.

The results of experimental investigations of the mass-kinetic energy distributions of fission fragments for nuclei lighter than radium are analysed for the excitation energy interval from threshold up to 60 MeV. The influence of the energy surface structure near the saddle point on the formation of general properties of fragments is considered. 28 refs.; 9 figs.

9995 (INIS-SU—66, pp 58-65) **Collective motion in nuclear matter at low and high energies.** Solyakin, G.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Nuclear constants. Scientific-technical collection.

A comparison of kinematic characteristics of the collective motions in nuclear matter at low and high energies has been performed. The experimental data used in analysis are comprised of the nuclear fission at low energies and the deep spallation of heavy nuclei induced by relativistic particles at high energies. The connection between the collective processes at low and high energies is dicussed. It is shown that final result of the collective intranuclear motion for both cases consists in forming of stable or unstable massive fragments. The existence of the latter is confirmed by the results of independent experimental investigations. 21 refs.; 4 figs.; 2 tabs.

9996 (INIS-SU—68, pp 127-128) **Energy and yields of prompt γ-radiation of /sup 235/U and /sup 238/U fission fragments by 3.0 MeV neutrons.** Filatenkov, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9997 (INIS-SU—68, pp 129) **On the /sup 238/U energy level scheme from the (n,n'γ) reaction.** Filatenkov, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9998 (INIS-SU—68, pp 130) **Half-life of spontaneously fissile uranium-238 isomer.** Makarenko, V.E.; Molchanov, Yu.D.; Otroshchenko, G.A.; Yan'kov, G.B. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

9999 (INIS-SU—68, pp 131) **Half-life of Pu-236,238,240,242 spontaneous fission.** Selitskij, Yu.A.; Funshtejn, V.B.; Yakovlev, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10000 (ITEF—21(1988)) **Investigation on energy dependence of p-even and p-odd asymmetry of /sup 233/U fission fragment escape by polarized neutrons.** Beda, A.G.; Val'skij, G.V.; Danilyan, G.V.; Dronyaev, V.P.; Nazarenko, V.I.; Pavlov, V.S.; Shchenev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704809/JAW.

Energy dependence of p-even and p-odd asymmetry of /sup 233/U fission fragment escape by polarized neutrons is investigated. Investigation of the p-even effect energy dependence is carried out under conditions when the contribution of p-even asymmetry to the effect measured is reduced by two orders. The results obtained give definitely evidence that the energy dependence observed before in p-even asymmetry of /sup 233/U fission fragment escape has the physical nature when the sign changes at 0.15 eV neitron energy but it is not caused by the contribution of p-even asymmetry to the effect studied. 4 refs.; 3 figs.

10001 (LBL—26111) **Nuclear fission and transuranium elements: Fifty years ago.** Seaborg, G.T. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 22p. (CONF-880912—22). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004692/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

This paper reviews some historical aspects of the knowledge and discovery of transuranium elements. This fission of plutonium is discussed also. 12 refs., 6 figs.

10002 (PER—153) **Study of prompt neutron emission in thermal-neutron-induced fission of /sup 235/U.** Franklyn, C.B. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). Jan 1987. 174p. NTIS (US Sales Only), PC A08/MF A01 - OSTI. Order Number DE88704936/JAW.

An original experiment was performed to measure the angular correlation of fission neutrons from thermal-neutron-induced fission of /sup 235/U, with respect to the light fission fragment direction, as a function of fragment mass division and neutron energy. A

Monte Carlo model, was developed to simulate the observed neutron-fragment angular correlation data. The model was capable of investigating various possible forms of neutron emission which were classified into emission before, during and after full fragment acceleration, and correspondingly named scission acceleration and prompt neutron emission. Simulated neutron-fragment angular correlations displaying similar distributions with respect to the light fragment direction for different forms of neutron emission are shown to exhibit differing distributions when examined as a function of fragment mass division or neutron energy, thus illustrating the sensitivity of the experiment to the forms of neutron emission occurring in fission. A primary conclusion was that neutron emission solely from fully accelerated fragments was unable to adequately describe the observed neutron-fragment angular correlations. Simulation of the fission process with some neutron emission before or during fragment acceleration exhibited a closer correspondence with observed phenomena. The form of neutron emission that produced the closest overall correspondence with experimental data was a simulation in which 20% of the emitted neutrons were isotropically emitted scission neutrons with a Maxwellian energy distribution of temperature 1.0 MeV. The remaining neutrons were emitted from fully accelerated fragments, being isotropic in the fragment centre of mass frame, except for the n-th($n > 1$) neutrons from the light fragment, which were emitted anisotropically.

## 6530 Nuclear Theory

*REFER ALSO TO CITATION(S) 9793, 9847, 9867, 9877, 9955, 9968, 10002*

10003 **(CONF-881054—37) Oscillations of the polarized vacuum around a large Z(~180) "Nucleus".** Kumano, S.; Iwazaki, A. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy; Nishogakusha Univ., Chiba (Japan). Dept. of Physics). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004184/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

We investigate a possible explanation of sharp $e^+$ peaks in heavy-ion collisions by analyzing a collective phenomenon in QED. We show that a highly polarized vacuum around a large Z "nucleus" has at least two neutral oscillation modes, whose energies are calculated to be 1.8 Mev and 1.5 Mev with an appropriate choice of the nuclear radius. They decay into a pair of e/sup {+-}/ through electromagnetic interactions. 10 refs., 3 figs.

10004 **(CTA-IEAV-RP—003/85) Polarizations in neutron-deuteron elastic scattering.** Frederico, T. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados). Feb 1985. 156p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704681/JAW.

The polarizations in n-d elastic scattering and the correlations between observables for the J/sup P/=1/2/sup +/ state are studied using the method of Mitra, the integral equations for the n-d amplitudes with a one term separable potential with no restrictions on the multipolarity, are derived. The agreement between the proposed calculation and the 10 MeV p-d experimental results for the spin-correlations C/sub xx/ and C sub(yy) and N-N spin-transfers K/sub x//sup x'/, K/sub y//sup y'/ and K sub (z)/sup x'/ by phenomenologically introducing the value of the /sup 2/S amplitude (an experimental p-d datum) and using for the others amplitudes a one term separable potential with S,P and tensor components, are shown. The /sup 2/S amplitude is critical these second order polarizations observables and, given the discrepancies between p-d and n-d experimental phase-shifts for this wave, the value of /sup 2/S with the use of the correlation between Kcot/sup 2/ δ o and /sup 2/a (doublet scattering length) is obtained the n-d / sup 2/S results agree with p-d experimental data above 4 MeV. The correlation between Kcotg/sup 2/ δ o and E/sub T/ (Triton binding energy) with /sup 2/a within the zero range model. The propreties that Kcotg /sup 2/ δ o vs. /sup 2/a and E/sub T/ vs. / sup 2/a have in a model with finite range V-N potential are not completely reproduced in the zero range model, is studied.

10005 **(DOE/ER/40145—3) Research in theoretical nuclear physics: Progress report, 1 November 1987--31 October 1988.** (Texas Univ., Austin (USA). Dept. of Physics). Nov 1988. Contract FG05-84ER40145. 40p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004686/JAW.

This report contains short papers on the following topics: reactions induced by light ions; reactions induced by heavy ions; medium energy physics; and nuclear structure. 17 figs. (LSP)

10006 **(DOE/ER/40283—3) Theoretical studies of multistep processes, isospin effects in nuclear scattering, and meson and baryon interactions in nuclear physics: Annual progess report, 1 May 1988--30 April 1989.** Landau, R.H.; Madsen, V.A. (Oregon State Univ., Corvallis (USA). Dept. of Physics). 25 Oct 1988. Contract FG06-86ER40283. 25p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004648/JAW.

A progress report is presented for DOE grant FG06-86ER40283 supporting theoretical studies in nuclear and particle physics at Oregon State University. The research was led by Professors Landau and Madsen, and carried out in collaboration with graduate students in Corvallis, and scientists at LLNL-Livermore, TRIUMF, KFA-Juelich, Purdue University, and Florida State University. The studies include meson-exchange-current effects, quark effects, and relativistic (Dirac) effects deduced from spin observables in p-$^3$He scattering, atomic and nuclear Gamow states in momentum space of kaons and antiprotons, and charge-symmetry violation in pion scattering. Additional studies include microscopic optical potential calculations, multiple step processes, and differences in neutron and proton multipole matrix elements and transition densities in low lying collective states and in giant resonances. 13 refs.

10007 **(DOE/ER/40283—4) Theoretical studies of multistep processes, isospin effects in nuclear scattering, and meson and baryon interactions in nuclear physics: Three year summary, 1 May 1986--30 April 1989.** Landau, R.H.; Madsen, V.A. (Oregon State Univ., Corvallis (USA)). 25 Oct 1988. Contract FG06-86ER40283. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004649/JAW.

A three-year summary is presented for DOE grant FG06-86ER40283 supporting theoretical studies in nuclear and particle physics at Oregon State University. The research was led by Professors Landau and Madsen, and carried out in collaboration with graduate students in Corvallis, and scientists at LLNL-Livermore, LLNL, Los Alamos, TRIUMF, KFA-Juelich, Purdue University, and Florida State University. The studies include meson-exchange-current effects, quark effects, and relativistic (Dirac) effects deduced from spin observable in p-$^3$He scattering, atomic and nuclear Gamow states in momentum space of kaons and antiprotons, and charge-symmetry violation in pion scattering. Additional studies include microscopic optical potential calculations, multiple step processes, and differences in neutron and proton multipole matrix elements and transition densities in low lying collective states and in giant resonances.

10008 **(DOE/ER/40283—5) Application of the schematic model to four-quasiparticle states.** Hoering, A. (Oregon State Univ., Corvallis (USA)). 31 Aug 1988. Contract FG06-86ER40283. 68p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004639/JAW.

The Tamm-Dancoff equation of motion for our BCS quasiparticles is derived. It is solved in the limit of degenerate energy levels using a separable interaction. The result is then applied to the coupling between collective states with two and four quasiparticles, which corresponds to a coupling between collective states with one and two phonons. A case of special interest involves the coupling of the collective two-quasiparticle state to the collective four-quasiparticle state. This interaction represents the leading-order anharmonic effect in the vibrational motion. Its effect on the energy level diagram and the strength of the crossover transition $2_2^+$ {yield} $0_1^+$ are investigated for $^{106}$Pd, $^{108}$Pd, $^{110}$Pd, $^{74}$Se, $^{76}$Se, and $^{78}$Se. 21 refs., 9 figs., 4 tabs.

10009 **(DOE/ER/40427—19-N8) Contribution of the axial charge operator to $2\nu$ $\beta\beta$-decay.** Williams, A.G.; Haxton, W.C. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 7p. (CONF-8805142—46). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004563/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We examine the possibility that the double axial charge operator could have a significant effect on the rates for $2\nu$ $\beta\beta$-decay. Although the new $\beta\beta$-decay operator is nominally suppressed by $(v/c)^2$, it is not subject to the Pauli effects that weaken allowed matrix elements. In standard shell model treatments of the double beta decay nuclei $^{76}$Ge, $^{82}$Se, and $^{130}$Te, this operator contributes as a first-order correction. By using the schematic Nilsson pairing model, we argue that core-polarization contributions generated by the quadrupole-quadrupole interaction will systematically cancel against the dominant Gamow-Teller amplitude. The contribution from the tensor force may also be important, but has not yet been evaluated. 10 refs., 2 figs., 2 tabs.

10010 **(DOE/ER/40427—25-N8) Pions in relativistic nuclear field theories.** Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1988. Contract FG06-88ER40427. 10p. (CONF-8806130—5). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004576/JAW.

From Relativistic nuclear many-body physics conference; Columbus, OH, USA (6 Jun 1988).

The saturation of nuclear matter is studied using a Lagrangian with a partially conserved axial vector current (PCAC). We present the results of a first calculation in which the standard mean field approximation, as augmented by the pionic ring series, achieves saturation with pionic effects supplying the main attraction. The scalar field ({phi}) effects are small, so that the resulting value of M - $g\pi$ <{phi}> is close to the nucleon mass, M. Effects of the medium on vacuum polarization are thereby suppressed. 18 refs., 3 figs.

10011 **(DOE/ER/40427—28-N8) Nuclear wave functions in deep inelastic scattering and Drell Yan processes.** Miller, G.A. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 12p. (CONF-880758—6). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004566/JAW.

From Workshop on nuclear and particle physics on the light cone; Los Alamos, NM, USA (18 Jul 1988).

The author discusses the evaluation of nucleonic effects in deep inelastic scattering and Drell-Yan processes. A convolution formula is derived. 26 refs., 9 figs.

10012 **(DOE/ER/40427—29-N8) Electron scattering and weak interactions.** Henley, E.M. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1988. Contract FG06-88ER40427. 8p. (CONF-8806236—3). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004567/JAW.

From First European workshop on hadronic physics in the 1990's with multi-GeV electrons; Seillac, France (27 Jun 1988).

Electron scattering is one of the best tools at our disposal for probing nuclear structure. It can also be used to test the electroweak theory through the measurement of parity-violation (PV) experiments. The difficulty of these experiments is offset, in part, by the additional sensitivity of the measured asymmetries to spin effects and by the short range nature of the weak interactions. Thus, PV experiments with electrons may be especially sensitive to short-range correlations and quark effects. This paper will investigate the use of electron scattering to uncovered physical nuclear properties at various energies. 7 refs., 6 figs.

10013 **(FRCEA-TH—79) Study of collective quadrupole excitation in samarium 144, 148, 150, 152, and 154 isotopes and cerium 140 by inelastic electron scattering.** Meot, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie; Paris-7 Univ., 75 (France)). Sep 1987. 158p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756130/JAW.

The region of Samarium nuclei where spectacular variations of nuclear deformation appear was investigated. Transition charge densities of the first 2/sup +/ states were determined by measuring the inelastic scattering cross sections of electrons on the six nuclei between 200 and 500 MeV. The experimental facilities and theoretical approaches which can be applied to nuclear dynamics are described. Experimental results are compared with interacting boson model calculations. The successes and limits of microscopic approaches are discussed. Although model and experiment agree for most of the cases studied, the transition charge densities of the 2/ sup +//sub 2/ and 2/sup +//sub 3/ states of Sm144 and Ce140 are in complete disagreement with all the theoretical models.

10014 **(GANIL-P—87-29) $\gamma$-rays as a probe to study nuclear dynamics and nuclear structure at intermediate energies.** Schutz, Y. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 17p. (CONF-8710373—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756151/JAW.

From Symposium on heavy-ion collisions; Shimoda, Japan (11 Oct 1987).

The usefulness of gamma rays in nuclear physics is reviewed, and it is shown how they offer insight into the structure and damping of giant resonances, and how they can be used as an isospin filter. Results from inclusive and exclusive experiments at GANIL are discussed. It is stressed that although the production of high energy gamma rays in heavy ion reactions between 30 MeV/A and 86 MeV/A is understood qualitatively, most models fail in being more quantitative.

10015 **(GANIL-P—88-03) Nuclear dynamics with the (finite range) Gogny force: flow effects.** Sebille, F.; Royer, G.; Remaud, B.; Schuck, P.; Gregoire, C. (Nantes Univ., 44 (France). Lab. de Spectroscopie Nucleaire; IRESTE, 44 - Nantes (FR); Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756154/JAW.

We introduce for the first time the effective finite range interaction of Gogny in the semi-classical description of heavy ion reactions based on the Landau-Vlasov equation. The characteristics of the flow for heavy ion collisions are studied as functions of the incident energy, the impact parameter and the mass number. The momentum dependence in the mean field together with the non linearities in the collision kernel decrease the flow in contradiction with other calculations; the origins of this discrepancy are studied in details.

10016 **(GSI—88-43-Prepr.) Dynamical instabilities in heavy-ion collisions.** Henning, P.A.; Friman, B.L. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1988. 37p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

Within the $\sigma\omega$ model for nuclear matter, an instability in a system of two counterstreaming fluids is discussed. This instability leads, if developed, to a separation of the two currents in space - a periodic structure orthogonal to the beam axis is finally obtained. In contrast to previous results by Ivanov, the maximal growth rate for the instability is shown to occur at a finite wavelength. Furthermore, these growth rates are much lower than calculated before. The influence of vacuum contributions is also discussed.

10017 **(GSI—88-50(prepr.)) Semiclassical and phase space approaches to dynamic and collisional problems of nuclei.** Hasse, R.W.; Jaenicke, J.; Schuck, P.; Gregoire, C.; Remaund, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires; Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France); IRESTE, 44 - Nantes (France); Nantes Univ., 44 (France)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires; Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France); Nantes Univ., 44 (France)). Sep 1988. 98p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

This article summarises recent work on the semiclassical (Thomas-Fermi like) treatment of nuclear correlations and dynamical problems. After a short outline of the general technique the nucleon-nucleus optical potential in the doorway approximation (2p-1h and 2h-1p intermediate states) is treated. The imaginary part serves to calculate the energy dependent correction to the real part. The level density parameter, occupation numbers, and the mean free path are discussed. The semiclassical treatment of the nuclear response function is given in detail. Applications to inelastic electron scattering in the quasi-elastic peak region are presented. Analogously, inelastic proton scattering is calculated. Because of the surface absorption this reaction excites the surface response. The imaginary part of the single-particle (hole) potential in the evaluation of the response function introduces a 2p-2h spreading. The missing charge in the longitudinal response is reduced but not all experimental puzzles can be explained. The experience gained in the description of phenomena close to equilibrium serves to construct solutions of the Landau-Vlasov (alias Vlasov-Uehling-Uhlenbeck) equation for the description of non-equilibrium processes encountered in heavy ion reactions.

10018 **(IFUSP-P—696) Comparisons between seniority, quasi-particle and shell model calculations: application to the odd Ni isotopes and odd N=82 isotones.** Losano, L.; Krmpotic, F.; Wildenthal, B.H.; Dias, H. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica; La Plata Univ. Nacional (Argentina). Dept. de Fisica; New Mexico Univ., Albuquerque (USA)). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 67p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705088/JAW.

A detailed study of shell model correlations induced into the BCS approximation by the number projection method and by blocking effect, has been carried out. The low seniority shell model was used as the frame of reference to investigate the mixing of one and three quasi particle states in odd-mass Ni isotopes and in odd-mass N=82 isotones. We discuss the results obtained for the energy spectra and electromagnetic decay properties. Effects of seniority - five configurations on the low lying states has also been studied through the comparison of low seniority shell model results with those which arise from the full shell model calculations.

10019 **(IFUSP-P—701) Glauber calculation of heavy-ion and light-ion inclusive break-up cross sections.** Hussein, M.S.; Mastroleo, R.C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica; Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 20p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705092/JAW.

The small-angle, single spectra of $\alpha$-particles in the reaction /sup 159/Tb(/sup 14/N, $\alpha$) at E/sub Lab/ = 95 MeV are qualitatively well reproduced with a simple hybrid model including break up of the /sup 14/N nucleus and the subsequent strong interaction of the /sup 10/B with the target. The Glauber approximation was employed for the purpose. The model is also tested in the reaction /sup 62/Ni ($\alpha$, /sup 3/He) at E/sup Lab//sub $\alpha$/ = 172.5 MeV.

10020 **(IFUSP-P—708) Matricial method to obtain sub-barrier fusion cross section from off-line X-ray measurement.** Pascholati, P.R.; Kodama, T.; Vanin, V.R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ; Strasbourg-1 Univ. (France). Centre de Recheches Nucleaires). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). May 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705095/JAW.

A matricial method to obtain heavy ion fusion cross sections from off-line detection of X-rays emitted by the evaporation residues is presented. The method uses analytical functions for the decay expressions. It can treat all decay branchings and any number of decay chains or any number of nuclides.

10021 **(IFUSP-P—710) Study of the /sup 16/O+/sup 64,66,68/Zn reactions: fusion and elastic scattering.** Tenreiro, C.F.; Acquadro, J.C.; Liguori Neto, R.; Freitas, P.A.B. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). May 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705097/JAW.

Excitation functions for the fusion of /sup 16/O with/sup 64,66/Zn in the energy range of 0,8-1,7 times the coulomb barrier were measured. Reduced fusion excitation functions, scaled to remove the geometrical effects show an isotopic effect in the excitation functions for sub-barrier energies. Furthermore, angular distributions for the elastic scattering were measured for the /sup 16/O+ 64,68/sup Zn/ systems in the energy range of 43 Mev to 56 Mev. An anomalous back-angle elastic scattering was observed for the /sup 16/O/sup 64/Zn system for energies around the coulomb barrier.

10022 **(INFN-BE—88-4) Fragmentation of the giant dipole resonance in an algebraic model.** Maino, G.; Ventura, A.; Zuffi, L. (ENEA, Bologna (Italy); Istituto Nazionale di Fisica Nucleare, Milan (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704908/JAW.

A phenomenological algebraic approach to nuclear dipole excitations is presented within the framework of the interacting boson model. The application to photon absorption and scattering by nuclei in regions of shape transitions and axially symmetric deformations is discussed. Finnally, an algebraic model for the coupling of giant dipole resonance states to fermion and isospin degrees of freedom is proposed and applied. 32 refs.

10023 **(INIS-BR—1364) Statistical contribution in the giant multipolar resonance decay in hevay nuclei.** Teruya, N. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 94p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705160/JAW.

Statistical calculations are made for the decay in the electric monopole giant resonance in /sup 208/Pb and electric dipole giant resonance in /sup 209/Bi, using the Hauser-Feshbach formalism. Calculations are done using the experimental energy levels of the corresponding residual nuclei. The particle-vibrator model is used for those experimental levels without spin and parity determination. The influence of different parametrizations of the optical potential in the statistical calculation result is also studied. (L.C.).

10024 **(INIS-BR—1365) Hartree-Fock approximation applied to nuclear structure problems.** Oliveira, D.R. de. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1972. 142p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705161/JAW.

The Hartree-Fock indepedent-particle state basis is firstly constructed, whose wave functions are expressed as linear combinations of states of a Known basis. The coefficients of these combinations are reals e from themselves the Hartree-Fock density matrix is defined. The symmetries which characterize the system in study are embedded in these coefficients and in the density matrix. The formalism is applied to the Ne/sup 20/, Si/sup 28/ and Ar/sup 36/ nuclei whose lowest Hartree-Fock energies are obtained admitting that theirs wave functions having axial symmetry. Once known the Hartree-Fock wave function, states are projected from it with well-

defined total angular momentum using the Peierls and Yoccoz method. From these wave functions energy levels of the ground band are calculated as well as the electric quadrupole transition probabilities among these levels. (L.C.).

10025 **(INIS-BR—1367) Isovector excitations in charge independent systems.** Menezes, D.P. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 65p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705163/JAW.

A method for building states with good isospin, from states given by the action of an isovector excitation operator on states of the parent multiplet is developed. This new method is a generalization of Toki's method and is applicable to cases involving any isovector excitation operator and a parent state, which is not a double magic nucleus. Once obtained these states with well defined isospin, it is shown how to do a Tamm-Dancoff calculation for determining the energy levels. The transition matrix elements of an isotensor operator are also calculated. An application of this formalism to the Gamow-Teller transition strength in /sup 90/Zr is studied. In this case, besides the double magic configuration, the 2 particles - 2 holes (PI1g/sub 9/2/)/sup 2/(υ 2p/sub 1/2//sup -1/)/sup 2/ configuration is also considered.

10026 **(INIS-BR—1378) Response function of spin-isospin nuclear excitations.** Salvetti, A.R. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 112p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705174/JAW.

The selected aspects of spin-isospir nuclear excitations are studied. The spreading width of M/ states in even Ca isotopes for the purpose of trying to understand the missing strenght specially in /sup 44/Ca, was estimated. The doorway calculation, was used, considering the level of complexity next to the independent particle M/ state. Using a nuclear matter context, the system response function to a spin-isospin probe and verify how the response function behaves for free fermions and in the ring approximation was studied. Higher correlations to polarization propagation such as the induced interaction and self-energy corrections was introduced. The dopping of colletive effects by such collisions terms was verified. It was investigate how to estimate the short range term of the effective interaction in the spin-isospin channel and the possibility of detecting a difference between these short range terms in the longitudinal and the transverse channel, for understanding the absence of pior condensation precursor states and negative results in a recent attempt to detect differences between longitudinal and transverse response functions one naively expects theoretically.

10027 (INIS-mf—11327, pp 55) **Schroedinger equation for neutron optics.** Sears, V.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10028 (INIS-SU—66, pp 92-100) **Nucleon elastic and quasielastic scattering on vanadium.** Titarenko, N.N.; Isakov, A.G.; Rudenskaya, E.O. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

A unified set of parameters of the neutron optical potential for the /sup 51/V nucleus is searched in the energy range 10 keV - 32 MeV so as to obtain a good agreement with all the available data. These include neutron strength function and elastic scattering data, as well as the neutron total cross sections and (p,n) isobaric analog state quasielastic scattering data. 34 refs.; 6 figs.; 3 tabs.

10029 (INIS-SU—66, pp 45-49) **New aspects of nuclear fissility description in the region of lead.** Ostapenko, Yu.B.; Rastopchin, E.M.; Smirenkin, G.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

Attention is being drown to the "chronic" difficulty in the description of nuclear fissibility in the region of lead. A possibility to overcome this difficulty is investigated in the framework of diffusion model. It has been shown, that consistent interpretation can be achieved assuming an enhancement of the nuclear level density due to the existence of second minimum in deformation energy. 15 refs.; 3 figs.

10030 (INIS-SU—66, pp 75-83) **Theoretical predictions and experimental tests of fission barriers of hot rotating nuclei.** Mustafa, M.G. (Lawrence Livermore National Lab., CA (USA)). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

Recent theoretical achievements in calculating fission barriers of hot rotating nuclei and their experimental tests are reviewed. The discussions are limited to macroscopic fission models (no shell effects), since experimental tests come primarily from heavy-ion induced reactions involving large angular momenta and internal excitation energies. The physics of the rotating finite range models with temperature is emphasized and the predictions of the model are compared with those of other macroscopic models and with statistically deduced experimental results. the difficulties associated with the statistical model analysis at high temperatures are discussed. 43 refs.; 8 figs.; 1 tab.

10031 (INIS-SU—66, pp 83-91) **/sup 239/Pu neutron cross sections in the resolved resonance region.** Luk'yanov, A.A.; Kolesov, V.V.; Toshkov, S.; Yaneva, N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

The multilevel parameters for the description of total and fission cross sections for /sup 239/Pu in the resolved resonance region up to 500 eV have been determined. The method for the constructions of the elastic scattering and radiative capture resonance cross sections using these parameters have been developed. Group averaged cross sections for experimental and evaluated data have been calculated in the considered energy interval. 25 refs.; 4 tabs.

10032 **(INIS-SU—66) Nuclear constants. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 108p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780045/JAW.

Voprosy atomnoj nauki i tekhniki.; No. 1.

Separate abstracts were prepared for the papers in this collection.

10033 (INIS-SU—68, pp 143) **Multichannel theory of the 0/sup +/ resonance of /sup 4/He nucleus.** Vasilevskij, V.S.; Kovalenko, T.P.; Filippov, G.F. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10034 (INIS-SU—68, pp 146) **Binding energy and states of fundamental band of chosen light nuclei in a model with strongly restricted dynamics.** Ruzha, Ya.Kh.; Guseva, T.V.; Tamberg, Yu.Ya.; Al'karas, I.A.K.; Sabalyauskas, L.Yu.; Vanagas, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10035 (INIS-SU—68, pp 147) **Coulomb interaction in the supermultiplet basis.** Ruzha, Ya.Kh.; Guseva, T.V.; Tamberg, Yu.Ya.; Vanagas, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10036 (INIS-SU—68, pp 148) **Bose condensation of phonons at rotation of nuclei.** Bastrukov, S.I.; Erokhin, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10037 (INIS-SU—68, pp 151) **EMC effect in the effective theories of nucleus.** Birbrair, B.L.; Levin, E.M.; Shuvaev, A.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10038 (INIS-SU—68, pp 170) **Multineutron /sup 3/n system in basic approximation of hyperspherical function method.** Gorbatov, A.M.; Komarov, P.V.; Krylov, Yu.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10039 (INIS-SU—68, pp 175) **Coulomb energy differences of light nuclei.** Kopanets, E.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10040 (INIS-SU—68, pp 187) **Fragmentation of quasiparticles in nuclei of magic +-1 nucleon number.** Kadmenskij, S.G.; Luk'yanovich, P.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10041 (INIS-SU—68, pp 188) **Restoration of isotopic invariance in quasiparticle representation.** Kuliev, A.A.; Salamov, D.I.; Balaev, S.K. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10042 (INIS-SU—68, pp 200) **Gamma decay of giant multipole resonances.** Voronov, V.V.; Mario Piris; Ponomarev, V.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10043 (INIS-SU—68, pp 201) **Spin-multipole responce functions in the quasiparticle-phonon model.** Vdovin, A.I.; Ponomarev, V.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10044 (INIS-SU—68, pp 203) **Microscopic determination of effective charge for IBM.** Efimov, A.D.; Mikhajlov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10045 (INIS-SU—68, pp 204) **E2-transitions between states of negative parity of Se and Kr isotopes (A=76-80).** Dojnikov, D.N.; Erokhina, K.I.; Efimov, A.D.; Mikhajlov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10046 (INIS-SU—68, pp 207) **On the description of 2/sup +/ and 3/sup -/ states of even samarium isotopes and their charge radii.** Krygin, G.B.; Mitroshin, V.E.; Fisenko, I.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10047 (INIS-SU—68, pp 209) **Calculation of ratio of proton and neutron deformation moments by the Hartree-Fock method.** Gonchar, V.Yu.; Inopin, E.V.; Tarasov, V.N.; Kirichenko, Yu.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10048 (INIS-SU—68, pp 210) **New shell Z=64 and phase transitions of nucleus shape in a region of N=82-90.** Berlovich, Eh.E.; Karpeshin, F.F. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10049 (INIS-SU—68, pp 213) **Pairing in a saddle point region.** Kuz'menko, N.K.; Mikhajlov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10050 (INIS-SU—68, pp 215) **Description of Pd isotope properties in IBM1.** Vlasnikov, A.K.; Mikhajlov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10051 (INIS-SU—68, pp 216) **Manifestation of nonaxiality in Ge and Pt isotopes.** Efimov, A.D.; Mikhajlov, V.M.; Tulina, T.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10052 (INIS-SU—68, pp 220) **Interaction of $\beta$ and $\gamma$-bands in deformed nuclei.** Choriev, B.Ch. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10053 (INIS-SU—68, pp 221) **On a problem of operator of E1-collective transitions.** Barts, B.I.; Kazarinov, M.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10054 (INIS-SU—68, pp 250) **Circular polarization of radiation in a case of l-forbidden M1(E1) - transitions.** Feresin, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10055 (INIS-SU—68, pp 252) **Calculation of particle parameters for longitudinal polarization of conversion electrons.** Guseva, I.S.; Listengarten, M.A.; Puronen, S.V.; Feresin, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10056 (INIS-SU—68, pp 141) **High spin excitation of / sup 15/N nucleus in the (e,e') and ($\pi$,$\pi$') reactions.** Goncharova, N.G.; Spevak, V.Ya. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10057 (INIS-SU—68, pp 351) **($\alpha$,Li) reactions on light nuclei.** Shvedov, A.A.; Nemets, O.F.; Rudchik, A.T. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10058 (INIS-SU—68, pp 352) **($\alpha$,H1) reactions in $\alpha$-particle interactions with light nuclei.** Shvedov, A.A.; Nemets, O.F.; Rudchik, A.T. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10059 (INIS-SU—68, pp 397) **Using of solution theory methods in heavy ion physics.** Kartavenko, V.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10060 (INIS-SU—68, pp 404) **Deep inelastic transfer reactions - new information source on nuclear properties.** Zagrebaev, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10061 (INIS-SU—68, pp 469) **Calculation of multiple Coulomb excitation of rotational states of deformed nuclei by heavy ions.** Ofengenden, S.R. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10062 (INIS-SU—68, pp 470) **Joint analysis of radar cross section fluctuations and angular distributions in heavy ion reactions.** Kun, S.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10063 (INIS-SU—68, pp 471) **Angular autocorrelation function in dissipative heavy ion collisions.** Kun, S.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10064 (INIS-SU—68, pp 472) **Statistic correlation analysis of /sup 12/C + /sup 28/Si and /sup 12/C + /sup 24/Mg scattering.** Kun, S.Yu.; Tsekhmistrenko, I.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10065 (INIS-SU—68, pp 473) **Energy shift between fusion and inelastic interaction barriers in heavy nucleus systems.** Il'inov, A.S.; Cherepanov, E.A.; Demin, A.G.; Utenkov, V.K.; Shirokovskij, I.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10066 (INIS-SU—68, pp 476) **Analysis of the /sup 14/C ($\alpha$,$\alpha'\gamma$)/sup 12/C reaction in the framework of compound nucleus model with account for exchange process and spin-orbit coupling.** Bogdanova, N.A.; Zelenskaya, N.S.; Teplov, I.B. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10067 (INIS-SU—68, pp 477) **Finite nucleus density matrix in compound nucleus model with account for exchange process and spin-orbit interaction.** Bogdanova, N.A.; Zelenskaya, N.S.; Teplov, I.B. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10068 (INIS-SU—68, pp 478) **Statistic multistage direct processes with compound particles in inclusive nuclear reactions.** Zhivopistsev, F.A.; Sukharevskij, V.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10069 (INIS-SU—68, pp 479) **Energy dependence of nuclear relaxation process in phenomenological SMDP+SMCP model.** Kabin, Eh.I.; Sukharevskij, V.G.; Khajmin, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10070 (INIS-SU—68, pp 480) **Angular anisotropy of charged particles emitted by deformed nuclei.** Aleshin, V.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10071 (INIS-SU—68, pp 481) **Quasifree knock out of nucleons from nuclei by protons.** Dzhavadov, A.V.; Mirabutalybov, M.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10072 (INIS-SU—68, pp 482) **Analysis of angular distributions in elastic /sup 7/Li+p scattering near the /sup 7/Li(p,n)/sup 7/Be reaction threshold.** Guzhovskij, B.Ya.; Lazarev, L.M.; Ershov, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10073 (INIS-SU—68, pp 484) **Separable potentials for calculations of nucleon knock-out reactions by intermediate energy k-mesons.** Berdnikov, Ya.A.; Ostroumov, V.I.; Shishlo, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10074 (INIS-SU—68, pp 485) **Calculation of the /sup 16/O(K/sup -/,π/sup -/)/sub Λ/sup 16/O reaction cross section with account of continuum.** Dobromyslov, M.B.; Knyr, V.A.; Mazur, A.I.; Smirnov, Yu.F. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10075 (INIS-SU—68, pp 486) **Hypernuclei photoproduction on light nuclei.** Kolesnikov, N.N.; Tarasov, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10076 (INIS-SU—68, pp 487) **Impulse distributions in nuclei electrodisintegration.** Vysotskij, G.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10077 (INIS-SU—68, pp 488) **Resonance systems decay in Coulomb field of accompanied nuclear reaction products.** Karmanov, F.I.; Komarov, V.V.; Popova, A.M.; Shablov, V.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10078 (INIS-SU—68, pp 489) **On electron scattering on oriented nuclei.** Tartakovskij, V.K.; Lyong Zuen Fu; Fursaev, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10079 (INIS-SU—68, pp 491) **On neutrino nature.** Kerimov, B.K.; Buras, P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10080 (INIS-SU—68, pp 132-133) **Partial half-lifes of γ-transition in nuclei.** Bonch-Osmolovskaya, N.A.; Morozov, V.A.; Khudajberdiev, Eh.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10081 (INIS-SU—68, pp 140) **Partial cross sections of /sup 15/N nucleus photofission.** Goncharova, N.G.; Spevak, V.Ya. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10082 (INIS-SU—68, pp 228) **Double beta decay and neutrino mass.** Aliev, T.M.; Balaev, S.K.; Kuliev, A.A.; Salamov, D.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10083 (INIS-SU—68, pp 474) **Forbiddances factors for decay of odd /sup 223/Ra, /sup 233/U, /sup 231/Pa nuclei with even-even /sup 14/C and /sup 24/Ne cluster emission.** Bugrov, V.P.; Kadmenskij, S.G.; Furman, V.I.; Chuvil'skij, Yu.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10084 (INIS-SU—68, pp 475) **Approximate formula for calculation of preequilibrium component of nucleon energy distributions.** Seliverstov, V.A.; Stefanovich, N.K. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

10085 (INS—696) **Master equations in the microscopic theory of nuclear collective dynamics. Microscopic origin of dissipative processes and transport equation.** Matsuo, M.; Sakata, F.; Marumori, T.; Zhuo, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jul 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756042/JAW.

In the first half of this paper, the authors describe briefly a recent theoretical approach where the mechanism of the large-amplitude dissipative collective motions can be investigated on the basis of the microscopic theory of nuclear collective dynamics. Namely, we derive the general coupled master equations which can disclose, in the framework of the TDHF theory, not only nonlinear dynamics among the collective and the single-particle modes of motion but also microscopic dynamics responsible for the dissipative processes. In the latter half, the authors investigate, without relying on any statistical hypothesis, one possible microscopic origin which leads us to the transport equation of the Fokker-Planck type so that usefullness of the general framework is demonstrated.

10086 (INS—698) **Nucleon molecular orbitals and the transition mechanism between molecular orbitals in nucleus-nucleus collisions.** Imanishi, B.; Misono, S.; von Oertzen, W.; Voit, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756044/JAW.

The molecular orbitals of the nucleon(s) in nucleus-nucleus collisions are dynamically defined as a linear combination of nucleon single-particle orbits (LCNO) in a rotating frame by using the coupled-reaction-channel (CRC) theory. Nucleon molecular orbitals and the promotions of nucleon, - especially due to the Landau-

Zener radial coupling are discussed with the method above mentioned.

10087 **(ITEF—72(1987)) Methodical problems of calculation of nucleus-nucleus interactions in the intranuclear cascade model.** Andryakov, A.D.; Sibirtsev, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704816/JAW.

Methodical problems of calculation of nucleus-nucleus interactions in the framework of the intranuclear cascade model (ICM) are analyzed. The main demerits of the existing versions, the ways of their overcoming are considered and recommendations concerning ICM development for nucleus-nucleus interactions are elaborated. 20 refs.; 5 figs.

10088 **(KFK—4446) Investigations of direct and sequential Coulomb break-up of light ions.** Srivastava, D.K.; Basu, D.N.; Rebel, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jul 1988. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755973/JAW.

Coulomb dissociation of /sup 6/Li in the field of /sup 208/Pb at different energies via resonance and continuum levels is discussed in detail. Relations are given which can be used to directly relate the Coulomb break-up cross section to the astrophysical S-factor. Predictions for energy dependence and angular-distributions are given. The direct Coulomb break-up of /sup 6/Li is found to be of the same order of magnitude as the sequential break-up at higher projectile energies. The effect to eleastic scattering can be accounted for by introducing a dynamic polarization potential. Predictions are given for the direct Coulomb dissociation of 26 MeV/nucleon / sup 7/Li and /sup 16/O incident on /sup 208/Pb through dipole transitions to the continuum, and for /sup 20/Ne via quadrupole transitions in similar experimental situations.

10089 **(LA-UR—88-3342) Theory of neutron emission in fission.** Madland, D.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-8804213—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002041/JAW.

From American Nuclear Society conference on fifty years with nuclear fission; Gaithersburg, MD, USA (26 Apr 1988).

Neutron emission in fission is usually described in terms of two observables: the energy spectrum of emitted neutrons N(E) and the average number of neutrons emitted per fission, or average neutron multiplicity, {bar v}p. These observables are measured before the residual fission fragments decay toward the valley of $\beta$ stability and are therefore referred to as the prompt neutron spectrum N(E) and the average prompt neutron multiplicity {bar v}p. They are of fundamental importance to the design of macroscopic systems that are driven by the fission reaction, such as thermal or fast reactors. It is the purpose of this paper to describe existing theoretical models for these two observables. Other observables for neutron emission in fission will not be described here due to space limitations. 12 refs., 2 figs.

10090 **(N—88-30402) Eikonal solutions to optical model coupled-channel equations.** Cucinotta, F.A.; Khandelwal, G.S.; Maung, K.M.; Townsend, L.W.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Nov 1988. 30p. (NASA-TP—2830; L—16462; NAS—1.60:2830). NTIS, PC A03/MF A01.

Methods of solution are presented for the Eikonal form of the nucleus-nucleus coupled-channel scattering amplitudes. Analytic solutions are obtained for the second-order optical potential for elastic scattering. A numerical comparison is made between the first and second order optical model solutions for elastic and inelastic scattering of H-1 and He-4 on C-12. The effects of bound-state excitations on total and reaction cross sections are also estimated.

10091 **(N—89-10612) Multiple nucleon knockout by Coulomb dissociation in relativistic heavy-ion collisions.** Cucinotta, F.A.; Norbury, J.W.; Townsend, L.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Nov 1988. 7p. (NASA-TM—4070; L—16466; NAS—1.15:4070). NTIS, PC A02/MF A01.

The Coulomb dissociation contributions to fragmentation cross sections in relativistic heavy ion collisions, where more than one nucleon is removed, are estimated using the Weizsacker-Williams method of virtual quanta. Photonuclear cross sections taken from experimental results were used to fold into target photon number spectra calculated with the Weizsacker-Williams method. Calculations for several projectile target combinations over a wide range of charge numbers, and a wide range of incident projectile energies, are reported. These results suggest that multiple nucleon knockout by the Coulomb field may be of negligible importance in galactic heavy ion studies for projectiles lighter than Fe-56.

10092 **(N—89-11500) Gauged Q-balls.** Lee, K.; Stein-Schabes, J.A.; Watkins, R.; Widrow, L.M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1988. 25p. (NASA-CR—183369; NAS—1.26:183369; FERMILAB-PUB—88/139-A). NTIS, PC A03/MF A01.

Classical non-topological soliton configurations are considered within the theory of a complex scalar field with a gauged U symmetry. Their existence and stability against dispersion are demonstrated and some of their properties are investigated analytically and numerically. The soliton configuration is such that inside the soliton the local U symmetry is broken, the gauge field becomes massive and for a range of values of the coupling constants the soliton becomes a superconductor pushing the charge to the surface. Furthermore, because of the repulsive Coulomb force, there is a maximum size for these objects, making impossible the existence of Q-matter in bulk form. Also briefly discussed are solitons with fermions in a U gauge theory.

10093 **(N—89-11501) Decay of highly excited open strings.** Mitchell, D.; Turok, N.; Wilkinson, R.; Jetzer, P. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1988. 37p. (NASA-CR—183364; NAS—1.26:183364; FERMILAB-PUB—88/78-A). NTIS, PC A03/MF A01.

The decay rates of leading edge Regge trajectory states are calculated for very high level number in open bosonic string theories, ignoring tachyon final states. The optical theorem simplifies the analysis while enabling identification of the different mass level decay channels. The main result is that (in four dimensions) the greatest single channel is the emission of a single photon and a state of the next mass level down. A simple asymptotic formula for arbitrarily high level number is given for this process. Also calculated is the total decay rate exactly up to N=100. It shows little variation over this range but appears to decrease for larger N. The formalism is checked in examples and the decay rate of the first excited level calculated for open superstring theories. The calculation may also have implications for high spin meson resonances.

10094 **(NEI-NO—64) Quasiparticle-plus-core coupling model in well deformed nuclei. The Coriolis attenuation problem.** Johansen, E.F. (Oslo Univ. (Norway). Fysisk Inst.). Mar 1987. 90p. University of Oslo, Institute of Physics, Blindern, Oslo 3.

A method for determining the parameters in the Quasiparticle-Plus-Core (QPC) rigid rotor model is developed through a comparison with the Particle-Rotor Model (PRM). The numerical results of this choice of core model for /sup 163/Er, /sup 167/Er, and /sup 235/U are presented and discussed. The results clearly exhibit the close relationship between the QPC model rigid rotor core and the PRM model. 49 refs.

10095 **First-forbidden beta decay near A = 40.** Warburton, E.K.; Becker, J.A.; Brown, B.A.; Millener, D.J. (Brookhaven National Laboratory, Upton, New York 11973). *Annals of Physics (New York);* **187**: No. 2, 471-501(1 Nov 1988).

Shell model calculations in the full sdpf model space are carried out for the known and possible first-forbidden beta decays for $34<A<44$. The main purpose is to study the strong quenching of the unique ($\Delta J = 2$) decays, which results from the repulsive nature of the $T = 1$ particle—hole interaction, and the strong meson-exchange enhancement of the $\Delta J = 0$ decays. Procedures for calculating the relevant matrix elements and combining them to form the decay rate are described in detail. Various approximations designed to display more clearly the dependence of the rates on the contributing matrix elements are presented and the associated errors assessed. The results are compared to experiment and conclusions are drawn regarding our present understanding of first-forbidden beta decays. copyright 1988 Academic Press, Inc.

## 6540 Radiation And Shielding Physics

*REFER ALSO TO CITATION(S) 8676*

10096 **(AD-A—197983/0/XAB) Predictive signature modeling via solid geometry at the BRL (Ballistic Research Laboratory). Final memo report.** Deitz, P.H. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Feb 1988. 36p. (BRL-MR—3664). NTIS, PC A03/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

For almost two decades the BRL has generated solid-geometric models for use in vulnerability and neutron-transport calculations. In the past four years, the Laboratory has embarked on a two-phase program to 1) improve its ability to generate, display, and modify geometry, and 2) couple geometry and related attribute data to a diverse set of analysis codes. Over the past year, substantial attention has been given to the development of a predictive signature capability. This report reviews current progress in solid-geometric modeling to include examples of color-shaded renderings of weapons-systems currently under analysis. In addition, new results of signature models and supporting codes will be discussed and illustrated.

10097 **(Juel—2203) HERMES - a Monte Carlo program system for beam-materials interaction studies.** Cloth, P.; Filges, D.; Neef, R.D.; Sterzenbach, G.; Reul, C.; Armstrong, T.W.; Colborn, B.L.; Anders, B.; Brueckmann, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). May 1988. 249p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756189/JAW.

FORTRAN 77; IBM 3081, CRAY/XMP22.

HERMES (High Energy Radiation Monte Carlo Elaborate System) is a system of Monte-Carlo computer codes that are necessary to treat the different physics to be considered in computer simulation of radiation transport and interaction problems. The HERMES collection of physics programs permits the simulation of secondary particle histories induced by primary particles of any energy up to the regime of high-energy physics and down to thermal energies, e.g. for neutrons. The particles, that are considered by the programs of the HERMES system are p, n, $\pi$/sup +/, $\pi$/sup -/, $\pi$/sup 0/, $\pi$/sup +-/, e/sup +/, e/sup -/, $\gamma$, and light ions to $A=10$. The programs of the HERMES system have been taken as original codes as far as possible. To satisfy the needs of some applications, extensions and changes became necessary. Also the interfacing technique by HERMES submission files needs some additional programming. All changes made to the original codes are documented.

10098 **(Juel-Spez—443) Neutrons at COSY. A workshop at Kernforschungsanlage Juelich, February 22-23, 1988.** Filges, D.; Freiesleben, H. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). May 1988. 217p. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

For many years neutrons were considered important both as a useful probe in nuclear physics research and as an initiator and catalyst for fission, fusion and other applications. As a result knowledge about neutrons, especially below 20 MeV, received organized world-wide attention. Research with neutrons at medium energies, say 50 MeV to several GeV, has not consistently received attention and no systematic evaluations exist. But there is a large and considerable interest today because medium energy neutrons are very important in basic science and technology. The aim of this workshop was to provide an overview of the present status and the research which should be carried out in this field in future and which kind of experiments should be performed at the COSY facility: State-of-the-art about medium energy neutron experiments and existing facilities; planned experiments; needs for experiments doing research with neutrons at COSY (detectors, accelerator requirements, time structure etc.); what will be a first experiment to measure neutrons at COSY. The interest in this workshop is documented by a large number of participants. Copies of the viewgraphs of the talks are provided.

10099 **(KEK—88-4) Shielding calculations using FLUKA. Comparison with simple equations.** Yamaguchi, Chiri; Tesch, K.; Dinter, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756074/JAW.

The dose equivalent on the surface of concrete shielding has been calculated using the Monte Carlo code FLUKA86 for incident proton energies from 10 to 800 GeV. The results have been compared with some simple equations. The value of the angular dependent parameter in Moyer's equation has been calculated from the locations where the values of the maximum dose equivalent occur.

10100 **New buildup factor data for point kernel calculations.** Trubey, D.K.; Harima, Y. (NRC Technical Data Management Center, Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 503-511 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

An American Nuclear Society Standards Committee Working Group, identified as ANS-6.4.3, is developing a set of evaluated gamma-ray isotropic point-source buildup factors and attenuation coefficients for a standard reference data base. As a first step, a largely unpublished set of buildup factors calculated with the moments method has been evaluated by recalculating key values with Monte Carlo, integral transport, and discrete ordinates methods. Attention is being given to frequently-neglected processes such as bremsstrahlung and the effect of introducing a tissue phantom behind the shield. The proposed standard contains data for a source energy range from 15 keV to 15 MeV and for approximately 19 elements and 3 mixtures (water, air, and concrete). The data are also represented as coefficients for the G-P fitting function. The 1985 data base was released as part of the CCC-493B/QAD-CGGP code package available from the Radiation Shielding Information Center (RSIC).

10101 **One and two dimensional radiation analysis of the Compact Ignition Tokamak.** Selcow, E.C. (Fusion Engineering Design Center, Grumman Corp. (US)). pp 197-206 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

The Compact Ignition Tokamak (CIT) is being proposed as the next major fusion experiment to follow the operations of the Tokamak Fusion Test Reactor (TFTR). CIT is a compact deuterium-tritium-burning tokamak device that is designed to achieve ignition. The high neutron wall loadings, 7-9 MW/m/sup 2/, associated with the operation of this device require that neutronics-related issues be considered in the overall system design. Radiation shielding is required for the protection of both device components and personnel. A close-in igloo shield, 1.8 m nominal thickness, has been designed around the periphery of the tokamak structure to permit personnel access into the test cell after shutdown and to limit the total activation of the test cell components. This paper dis-

cusses the major neutronics issues related to the design of the Compact Ignition Experiment, describes the methodologies used to quantify these concerns, and presents the results of radiation transport and activation scoping studies.

10102 **Verification of a Monte Carlo code system for analysis of ionization chamber responses.** Johnson, J.O.; Gabriel, T.A. (Oak Ridge National Lab. (US)). pp 110-122 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

The purpose of this work was the development and testing of a Monte Carlo code system for calculating an ionization chamber response to a mixed neutron and photon radiation environment. The resulting code system entitled MICAP - a Monte Carlo Ionization Chamber Analysis Package - determines the neutron, photon, and total response of the ionization chamber to the mixed field radiation environment. To demonstrate the ability of MICAP, comparisons were made with existing code systems and experimental results. Comparisons with existing code systems verified the accuracy of the neutron, photon, and charged particle transport processes and the nuclear models used to describe the individual neutron reactions. Comparisons with mono-energetic photon calibration experiments and mixed neutron and photon radiation experiments verified the applicability of MICAP for analysis of ionization chamber responses to mixed field radiation environments. The major conclusion of the study is that MICAP represents a unique capability in the area of ionization chamber response analysis and is expected to be useful for many applications in the field of radiation dosimetry.

10103 **Group structure and weighting function effects on neutron penetration through thick sodium-iron shields.** Fu, C.Y.; Ingersoll, D.T. (Oak Ridge National Lab. (US)). pp 158-167 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

The effects of group structures and weighting functions on neutron penetration through a thick Na-Fe geometry are studied. The recommended broad-group (61-neutron/23-gamma-ray) and few-group (22-neutron/10-gamma-ray) structures are tailored to the sodium and iron resonances, windows, and capture gamma-ray spectra. The best weighting functions are shown to be fine-group fluxes selected from a few key locations in the geometry. These group structures and weighting functions, relative to existing group structures and conventional weighting functions, improve the accuracy of the computed 61-neutron-group Bonner ball responses by up to one hundred percent and of the computed 22-neutron-group results by up to six hundred percent.

10104 **JASPER: A joint U.S.-Japan program of experimental shielding research.** Ingersoll, D.T.; Ohtani, N. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 346-353 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A cooperative shielding research program between the U.S. Department of Energy and Japan's Power Reactor and Nuclear Fuel Development Corporation has been initiated. The program includes six specific shielding integral experiments to be performed at the Oak Ridge National Laboratory Tower Shielding Facility and analyzed by both U.S. and Japanese participants. Planned experiments include studies of (1) attenuation in radial shield mockups, (2) neutron streaming in a fission gas plenum, (3) shield effectiveness of different axial shield designs, (4) neutron streaming in narrow gaps, (5) source multiplication effects within in-vessel stored fuel assemblies, and (6) sodium activation in an intermediate heat exchanger mockup. The first experiment, which included numerous configurations containing steel, graphite, and boron carbide, has been completed and initial results are presented. The remaining four experiments, which are in various stages of planning, fabrication and execution, are described briefly.

10105 **Numeric algorithms for parallel processors computer architectures with applications to the few-groups neutron diffusion equations.** Zee, S.K. Raleigh, NC; North Carolina State Univ. (1987). 193p. University Microfilms Order No. 88-00,132.

Thesis (Ph. D.).

A numeric algorithm and an associated computer code were developed for the rapid solution of the finite-difference method representation of the few-group neutron-diffusion equations on parallel computers. Applications of the numeric algorithm on both SIMD (vector pipeline) and MIMD/SIMD (multi-CUP/vector pipeline) architectures were explored. The algorithm was successfully implemented in the two-group, 3-D neutron diffusion computer code named DIFPAR3D (DIFfusion PARallel 3-Dimension). Numerical-solution techniques used in the code include the Chebyshev polynomial acceleration technique in conjunction with the power method of outer iteration. For inner iterations, a parallel form of red-black (cyclic) line SOR with automated determination of group dependent relaxation factors and iteration numbers required to achieve specified inner iteration error tolerance is incorporated. The code employs a macroscopic depletion model with trace capability for selected fission products' transients and critical boron. In addition to this, moderator and fuel temperature feedback models are also incorporated into the DIFPAR3D code, for realistic simulation of power reactor cores. The physics models used were proven acceptable in separate benchmarking studies.

## 6550 Medical Physics

*REFER ALSO TO CITATION(S) 7824, 7834, 9037, 9077, 9268, 9503, 9507, 10100, 10100*

10106 **(AECL—9100) Optimization of the estimation of carbon-14 in urine.** Kramer, G.H.; Bouchard, P.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1987. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704983/JAW.

The urinalysis method for carbon-14 currently used by the bioassay laboratory of the Dosimetric Research Branch at CRNL has been tested and optimized for both sensitivity and efficiency. Urine is first treated with an enzyme that catalyses the hydrolysis of urea, the major carbon-containing component of urine; carbon dioxide is then liberated by the measured addition of excess acid and collected in 2-aminoethanol. The aminoethanol can be directly counted by the addition of a liquid scintillation cocktail. This method can be used to measure both the specific activity, (Bq/g-carbon) or the total activity of carbon-14 released from the urine sample.

10107 **(AECL—9181) Radiation risks and radiation protection at CRNL.** Myers, D.K. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1986. 35p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704988/JAW.

Radiation exposure is an occupational hazard at CRNL. The predicted health effects of low levels of radiation are described and compared with other hazards of living. Data related to the health of radiation workers are also considered. Special attention is given to the expected effects of radiation on the unborn child. Measures taken to protect CRNL employees against undue occupational exposure to radiation are noted.

10108 **(BMU—1988-179) Neutron exposure analysis in reactors. Final report.** Jacobi, W.; Wittmann, A.; Kollerbaur, J.; Morhart, A.; Schraube, H.; Burger, G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). 1988. 139p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The purpose of this study was to make a radiation risk analysis for occupational exposure to neutrons of reactor personnel. The neutron exposure was analysed at selected, typical places of work by comparing theoretical and experimental dosemeter readings with particular regard to albedo dosemeters, and by theoretical calculation of body doses (and risks) on the basis of theoretical spectra and spectra determined indirectly by means of the multi-sphere method.

10109 **(CEA-R—5464) Experiments for the validation of computer codes uses to assess the protection factors afforded by dwellings.** Le Grand, J.; Roux, Y.; Kerlau, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Sep 1988. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756240/JAW.

Two experimental campaigns were carried out to verify: 1) the method of assessing the mean kerma in a household used in the computer code BILL calculating the protection factor afforded by dwellings; 2) in what conditions the kerma calculated in cubic meshes of a given size (code PIECE) agreed with TLD measurements. To that purpose, a house was built near the caesium 137 source of the Ecosystem irradiator located at the Cadarache Nuclear Research Center. During the first campaign, four experiments with different house characteristics were conducted. Some 50 TLSs locations describing the inhabitable volume were defined in order to obtain the mean kerma. 16 locations were considered outside the house. During the second campaign a cobalt 60 source was installed on the side. Only five measurement locations were defined, each with 6 TLDs. The results of dosimetric measurements are presented and compared with the calculations of the two computer codes. The effects of wall heterogeneity were also studied.

10110 **(CONF-881151—41) Modular design of H/sup {minus}/ synchrotrons for radiation therapy.** Martin, R.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003967/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A modular synchrotron for accelerating H/sup {minus}/ ions, and a proton beam delivery system are being developed for radiation therapy with protons under SBIR grants from the National Cancer Institute. The advantage proposed for accelerating H/sup {minus}/ ions and utilizing change exchange as a slow extraction mechanism lies in enhanced control for the extracted beam current, important for beam delivery with raster scanning for 3D dose contouring of a tumor site. Under these grants prototype magnets and vacuum systems are being constructed, appropriate H/sup {minus}/ sources are being developed and beam experiments will be carried out to demonstrate some of the key issues of this concept. The status of this program is described along with a discussion of a relatively inexpensive beam delivery system and a proposed program for its development. 3 refs.

10111 **(CONF-881151—42) A proton medical accelerator by the SBIR route: An example of technology transfer.** Martin, R.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003966/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

Medical facilities for radiation treatment of cancer with protons have been established in many laboratories throughout the world. Essentially all of these have been designed as physics facilities, however, because of the requirement for protons up to 250 MeV. Most of the experience in this branch of accelerator technology lies in the national laboratories and a few large universities. A major issue is the transfer of this technology to the commercial sector to provide hospitals with simple, reliable, and relatively inexpensive accelerators for this application. The author has chosen the SBIR route to accomplish this goal. ACCTEK Associates have received grants from the National Cancer Institute for development of the medical accelerator and beam delivery systems. Considerable encouragement and help has been received from Argonne National Laboratory and the Department of Energy. The experiences to date and the pros and cons on this approach to commercializing medical accelerators are described. 4 refs., 1 fig.

10112 **(INFO—0184) Passive radon daughter dosimeters.** McElroy, R.G.C.; Johnson, J.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1986. 53p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705110/JAW.

On the basis of an extensive review of the recent literature concerning passive radon daughter dosimeters, we have reached the following conclusions: 1) Passive dosimeters for measuring radon are available and reliable. 2) There does not presently exist an acceptable passive dosimeter for radon daughters. There is little if any hope for the development of such a device in the foreseeable future. 3) We are pessimistic about the potential of 'semi-passive dosimeters' but are less firm about stating categorically that these devices cannot be developed into a useful radon daughter dosimeter. This report documents and justifies these conclusions. It does not address the question of the worker's acceptance of these devices because at the present time, no device is sufficiently advanced for this question to be meaningful. 118 refs.

10113 **(INFO—0199) Radiation exposures to technologists from nuclear medicine imaging procedures.** Sloboda, R.S.; Schmid, M.G.; Willis, C.P. (Pasqua Hospital, Regina, Saskatchewan (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). May 1986. 53p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705123/JAW.

Radiation exposures incurred by nuclear medicine technologists during diagnostic imaging and gamma camera quality control (QC) were measured on a procedural basis over a three-month period using a portable, low-range, self-reading ion chamber. A total of more than 400 measurements were made for 15 selected procedures. From these, mean procedural exposures and standard deviations were calculated. The results show that daily flood phantom QC, at 0.58 mR, and gated cardiac studies, at 0.45 mR, were the two greatest sources of exposure. Other procedures resulted in exposures varying roughly from 0.10 to 0.20 mR. Difficult patients were responsible for a doubling of technologist exposure for many procedures. Standard deviations were large for all procedures, averaging 65% of the mean values. Comparison of technologist exposure inferred from the procedural measurements with the time coincident collective dose equivalent recorded by the TLD service of the Radiation Protection Bureau indicates that approximately half of the collective technologist exposure arose from patient handling and flood QC.

10114 **(INFO—0214) Comparison of the rationale used in setting occupational exposure standards for ionizing radiation and hazardous chemical substances.** Halton, D.M. (Monserco Ltd., Mississauga, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1986. 167p. NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705128/JAW.

Ten chemicals which create significant occupational hazard are reviewed. They are toluene diisocyanate, hydrogen fluoride, n-hexane, carbon disulphide, cadmium, inorganic mercury, cobalt, nitroglycerol, silica and vinyl chloride. Each is discussed under the headings of physiological intake and elimination in humans, characteristics of acute and chronic toxicity, sites of occupational exposure and rationale for limits of such exposure. Since radioactive substances yield ionizing radiation as the common hazard the treatment of the current permissible levels of exposure is somewhat sim-

pler. Having set out industrial standards for exposure to hazardous substances and radionuclides, a detailed comparison is made. Exposure limits to ioninzing radiation are sufficiently low to remove the appearance of directly related injury. It is expected however that low level exposure may have a stochastic effect, that is, there is the possibility of a slightly increased incidence of neoplasms in a large exposed population, but numbers will be too small to be able to attribute any particular case to the exposure. TLVs on the other hand, depending on the particular chemical, may be high enough in the workplace to permit some directly related signs or symptoms in the exposed individual. 244 refs.

10115 **(INFO—0236) Measurements of the radioactivity of the thyroid with hand held survey meters.** Deschamps, M. (Radioprotection Inc., Ste. Julie, Quebec (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Apr 1987. 75p. (In French). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705135/JAW.

With the use of Iodine 123, 125 and 131 and some compounds of Technetium -99 m, a fraction of the isotopes can be trapped in the thyroid of the technicians. Hand-held radiation contamination or survey meters of nine (9) nuclear medicine departments were evaluated. None of the hand-held radiation monitors are completely satisfactory for the measure of thyroid uptake of the user. We discuss a class of equipment capable of measuring radiation emissions at the investigation level. Measurement at the action level is possible with meters having scintillation or proportional probes but none of them permits the discrimination in energy required for a quantitative evaluation of the radioisotopes used.

10116 **(INIS-BR—1379) Whole-body monitoring: Goiania case, Brazil.** Oliveira, C.A.N. de; Lourenco, M.C.; Dantas, B.M.; Lucena, E.A. de; Becker, P.H.B. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil)). 1988. 12p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705175/JAW.

Due to the radiological Cs accident in Goiania, Goias in September 1987, it became necessary to evaluate internal contamination levels of: individuals from the general public that for any reason had direct or indirect involvement with the radioactive source (group 1); occupationally involved persons (group 2). For each of these groups, procedures of whole body monitoring were developped. In order to attend group 1 individuals, the IRD/CNEN installed a whole body unit in the INAMPS General Hospital of Goiania in 11.08.87, which was later transferred to 121, 57 street, Central Sector in Goiania in 2.06.88. In this unit 547 people were monitored, 356 from group 1 and 241 from group 2, until 04.13.88. In the IRD whole body counter installation, 194 individuals were counted, 185 from group 2 and 9 from group 1. The frequency of monitoring of each individual was stablished according to the Cs activity present in the body or to the job that will be done. Some body burden activity curves for Cs 137 as a function of the time elapsed from the first measurement, are presented. There people from group 1 were measured in both counters, the IRD and the Goiania ones. The values obtained in both installations are compatible with the body activity X time curve.

10117 **(INIS-BR—1380) Triage and medical attention to victims. Organization and irradiated infirmary structure of Goiania General Hospital. Clinical-laboratorial and radiological evaluations.** Brandao-Mello, C.E. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil)). 1988. 1p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705176/JAW.

10118 **(INIS-BR—1382) Intern contamination in Goiania, Brazil.** Lipsztein, J.L.; Bertelli, L.; Rabello, D.; Azeredo, A.M.G.F.; Juliao, L.Q.C.; Santos, M.S.; Villalobos, J.P.; Freire, B.L.V. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil)). 1988. 2p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705178/JAW.

10119 **(INIS-BR—1383) Cytogenetic dosimetry in the Goiania accident, Brazil.** Ramalho, A.T.; Nascimento, A.C.; Brandao-Mello, C.E. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil)). 1988. 2p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705179/JAW.

10120 **(IPEN-PUB—198) Establishment of /sup 137/Cs radiation fields for instrument calibration.** Albuquerque, M. da P.P.; Caldas, L.V.E.; Xavier, M. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705203/JAW.

In order to study the energy dependence of clinical dosemeters, systems constituted of ionization chambers connected to special electrometers, many times their calibration with the gamma radiation of /sup 137/Cs is necessary. In this case, the radiation field characterization is fundamental. The source used presents and activity of 38,8 Tbq and belongs to the Calibration Laboratory of IPEN. Dosimetric films, gammagraphy films, ionization chambers and Lucite phantons were used. At the calibration distance, 80 cm (detector-source detection), the homogeneity of a 10 X 10 cm/sup 2/ radiation field was equal 68%.

10121 (JINR-D—9-87-105-Vol.2, pp 411-414) **Dose characteristics of neutrons with the energy from thermal to 20 MeV and protons at the energy range of 2-600 MeV.** Golovachik, V.T.; Kustarev, V.N.; Lebedev, V.N.; Savitskaya, E.N.; Sannikov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780034/JAW. (CONF-8610271—).

From 10. All-Union conference on charged-particle accelerators; Dubna, USSR (21 Oct 1986).

The international committee on radiation protection recommends to proceed from the value of the maximum equivalent dose in human body when estimating radiation danger of ionizing radiations. The given work was aimed at refining dose characteristics of neutrons with the energy from the thermal one to 20 MeV and of protons with the energy from 2 to 600 MeV. The values of the maximum equivalent dose, quality factor and isotropic coefficient of monoenergetic neutrons and protons, recommended for practical use, are given. 13 refs.; 3 figs.; 1 tab.

10122 **(PB—89-114524/XAB) Use of the effective dose equivalent concept of the International Commission on Radiological Protection by EPA (Environmental Protection Agency) is encouraged. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 27 Apr 1988. 4p. (SAB/RAC—88/026). NTIS, PC A02/MF A01.

While the EPA Science Advisory Board's Radiation Advisory Committee has repeatedly recommended that EPA use the effective dose equivalent concept of the International Commission on Radiological Protection in developing risk estimates and establishing regulations related to the exposure of humans to radionuclides in the environment, the EPA has not been consistent in its use of the effective dose equivalent concept or the weighting factors applied in quantifying dose. The Committee believes that effective dose equivalent, rather than dose equivalent to specific organs, should be applied as the basis for regulations dealing with radiation exposure. The Committee strongly encourages EPA to carefully examine its position on the effective dose equivalent concept, the numerical value of organ-specific weighting factors, and the application of effective dose equivalent in establishing regulations and strive to ensure consistency within EPA and between EPA and other government, national, and international recommendations.

10123 **(SSI—87-19) Radioactivity discharge and radiation doses in nuclear power plants.** (National Inst. of Radiation Protection, Stockholm (Sweden)). Jun 1987. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755688/JAW.

Compilation of discharges from nuclear power plants, given as standardized discharge and collective dose equivalent index, and a compilation of personnel doses. (O.S.).

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*REFER ALSO TO CITATION(S) 7914, 8123, 8124, 8144, 8183, 8209, 8210, 8211, 8212, 8213, 8214, 8215, 8251, 8252, 8289, 8290, 8291, 8292, 8293, 8294, 8295, 8296, 8297, 8298, 8299, 8300, 8303, 8304, 8305, 8306, 8307, 8308, 8309, 8310, 8311, 8312, 8313, 8314, 8315, 8316, 8317, 8318, 8320, 8321, 8322, 8323, 8324, 8325, 8326, 8327, 8328, 8329, 8330, 8331, 8332, 8333, 8334, 8335, 8336, 8337, 8338, 8339, 8340, 8341, 8342, 8343, 8344, 8345, 8346, 8347, 8348, 8349, 8351, 8418, 8437, 8438, 8439, 8440, 8441, 8442, 8443, 8668, 9768, 9769, 9800, 9801, 9813, 9943, 10476, 10589*

10124 **(AD-A—197583/8/XAB) Adsorption of CO and $O_2$ on Ni(111) at 8 k.** Beckerle, J.D.; Yang, Q.Y.; Johnson, A.D.; Ceyer, S.T. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1988. 18p. NTIS, PC A03/MF A01.

Pub. in Surface Science, Vol. 195, 77-93(1988).

The adsorption of carbon monoxide (CO) and oxygen ($O_2$) on Ni(111) at 8 K is studied by molecular-beam techniques coupled with high-resolution electron-energy-loss spectroscopy and work function measurements. The work functions are measured by a retarding-potential techniques using the HREEL spectrometer. The cryogenic crystal temperatures are attained by use of a liquid-helium cryostat described in detail. The total and normal components of the translational energy of the incident molecules are lowered to 0.3 and 0.02 kcal mol, respectively. No evidence for a trapped, physisorbed CO molecule or a physisorbed molecular $O_2$ species is observed in the limit of zero coverage.

10125 **(BNL—42066) Positron annihilation induced Auger electron emission.** Weiss, A.; Jibaly, M.; Lei, Chun; Mehl, D.; Mayer, R.; Lynn, K.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 3p. (CONF-8808122—12). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004532/JAW.

From 8. international conference on positron annihilation; Gent, Belgium (29 Aug 1988).

We report on measurements of Auger electron emission from Cu and Fe due to core hole excitations produced by the removal of core electrons by matter-antimatter annihilation. Estimates are developed of the probability of positrons annihilating with a 3p electron in these materials. Several important advantages of Positron annihilation induced Auger Electron Spectroscopy (PAES) for surface analysis are suggested. 10 refs., 2 figs.

10126 **(CBPF-NF—008/88) Electronic structure and isomer shifts of Sn halides.** Terra, J.; Guenzburger, D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 33p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705002/JAW.

The all-electron first-principles Discrete Variational method was employed to study the electronic structure of SnF/sub 4/, SnCl/sub 4/, SnBr/sub 4/ and SnI/sub 4/. Values of the electronic density at the Sn nucleus were derived and related to /sup 119/Sn Isomer Shifts to obtain the nuclear constant $\Delta$ <r/sup 2/>. Differences in values of rho(o) area discussed in terms of the chemical bonding between Sn and halogen atoms.

10127 **(CBPF-NF—026/88) Gap road: Main properties.** Sousa Vieira, M. da C. de; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705016/JAW.

The phase diagram, Lyapunov exponent and multifractality associated with an asymmetric map, which generates a new road to chaos, are presented. (M.C.K.).

10128 **(CBPF-NF—030/88) Surface magnetization of the Ising ferromagnet in semi-infinite cubic lattice: renormalization group approach.** Chame, A.M.N.; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 34p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705017/JAW.

The behaviour of the spontaneous surface and bulk magnetizations as function of the temperature for the Ising ferromagnet in a semi-infinitre cubic lattice for various ratios JS/JB (JS and JB are the surface and bulk coupling constants, respectively), is studied. The extraordinary transition where the surface maintains its magnetization as the bulk disorders, was study, in particular; a discontinuity on the first derivative of the surface magnetization at the bulk transition temperature was found. The criticality of the system (universality classes, critical exponents and amplitudes) is discussed. An unexpected slight lack of monotonicity of the surface magnetization as a function of JS/JB for JS/JB$<<$1, was observed.

10129 **(CBPF-NF—036/88) Amorphous magnetism in Mn/sub x/ Sn/sub 1-x/ alloys.** Drago, V.; Saitovitch, E.M.B.; Abd-Elmeguid, M.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705020/JAW.

Systematic low temperature in situ /sup 119/Sn Moessbauer effect (ME) studies in vapor quenched amorphous Mn/sub x/ Sn/sub 1-x/ (0.09$\leq$ x $\leq$0,95) alloys between 150 and 4.2 K, are presented. Its is shown that the magnetic behavior of the system is correctly displayed by the transferred magnetic hyperfine (hf) interactions, at the /sup 119/Sn site. A complete magnetic phase diagram is proposed, and the effect of an external magnetic field (up to about 3T) on the spin correlations in the spin-glass state is also discussed.

10130 **(CONF-881151—45) In situ ion irradiation/implantation studies in the HVEM-Tandem Facility at Argonne National Laboratory.** Allen, C.W.; Funk, L.L.; Ryan, E.A.; Taylor, A. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004284/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The HVEM-Tandem User Facility at Argonne National Laboratory interfaces two ion accelerators, a 2 MV tandem accelerator and a 650 kV ion implanter, to a 1.2 MV high voltage electron microscope. This combination allows experiments involving simultaneous ion irradiation/ion implantation, electron irradiation and electron microscopy/electron diffraction to be performed. In addition the availability of a variety of microscope sample holders permits these as well as other types of in situ experiments to be performed at temperatures ranging from 10-1300 K, with the sample in a stressed state or with simultaneous determination of electrical resistivity of the specimen. This paper summarizes the details of the Facility which are relevant to simultaneous ion beam material modification and electron microscopy, presents several current applications and briefly describes the straightforward mechanism for potential users to access this US Department of Energy supported facility. 7 refs., 1 fig., 1 tab.

10131 **(DOE/ER/45183—4) Materials research and beam line operation utilizing NSLS: Progress report.** Liedl, G.L. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). Oct 1988. Contract FG02-85ER45183. 47p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003251/JAW.

MATRIX, organized in 1980 to serve common interests of a group of scientists interested in synchrotron x-ray diffraction, operates beam line X-18A at NSLS for the benefit of the Materials Science and Engineering research community. Throughout this past year during Phase II shutdown of NSLS, a major effort was made to upgrade and improve the capabilities of the beam line. Major changes involve a change to total UHV operations, added new optics with a unique non-focusing monochromator and a focusing mirror, inclusion of beam line monitors, and the planning for simplified computer control. Research directly related to this project resulted in nine papers being published or submitted including one paper by a general user of the beam line. In addition, six other research papers on research complementary to the project by MATRIX members were published or submitted.

10132 **(DOE/ER/45208—4) [He atom surface spectroscopy: Surface lattice dynamics of insulators, metals and metal overlayers]: Progress report, May 1, 1988--April 30, 1989.** (Florida State Univ., Tallahassee (USA)). 1989. Contract FG05-85ER45208. 35p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005146/JAW.

The primary goal in the first three years of this grant was the construction of a state-of-the-art, Thermal Energy Atom Scattering (TEAS) instrument which employs He atoms as the probe for atom-surface spectroscopy experiments. The He atoms are scattered both elastically and inelastically from the crystal surface to provide both structural and dynamic information. The instrument is now in place, fully characterized and operational. Measurements were started at the end of the third year and, currently, in the fourth year, are fully underway. The initial experiments, using LiF in the characterization of the apparatus, have been followed by RbCl, KBr, RbBr and NaI. The RbCl, KBr and RbBr were selected because they offer opportunities to explore relaxation effects for crystal surfaces and to examine predictions of "extended and mirror symmetry". More generally, the theoretical surface dynamics calculations for the alkali halides suggest a greater sensitivity to the features of the shell model for these heavier alkali halides, so that definitive experiments could provide stringent tests on the adequacy of the shell model to describe the lattice dynamics of the alkali halides and other ionic insulators. Experiments are expected to begin in the very near future on crystals such as KCN and $KMnF_3$ which will further test these ideas. Later in this year we plan to begin experiments on a very different class of materials: metallic modulated structures and overlayers. 37 refs., 14 figs., 2 tabs.

10133 **(INIS-BR—1368) On the phase transition nature in compressible Ising models.** Ota, A.T. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1985. 47p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705164/JAW.

The phase transition phenomenon is analysed in a compressible ferromagnetic Ising model at null field, through the mean-field approximation. The model studied is d-dimensional under the magnetic point of view and one-dimensional under the elastic point of view. This is achieved keeping the compressive interactions among the ions and rejecting annealing forces completely. The exchange parameter J is linear and the elastic potential quadratic in relation to the microscopic shifts of the lattice. In the one-dimensional case, this model shows no phase transition. In the two-dimensional case, the role of the S/sub i/ spin of the i-the ion is crucial: a) for spin 1/2 the transitions are of second order; b) for spin 1, desides the second order transitions there is a three-critical point and a first-order transitions line. (L.C.).

10134 **(INIS-BR—1377) Study of uniaxial nematic lyomesophases by x-ray diffraction and auxiliary techniques.** Bittencourt, D.R.S. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. 181p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705173/JAW.

The uniaxial lyotropic nematic liquid crystals made of amphiphile/water/decanol/salt have been studied. The amphiphiles sodium decyl sulphate and sodium dodecil sulphate have been used. Characterization of samples conditioned in plane and cylindrical cells has been made by orthoscopic polarized optical microscopy (OM) and X.ray diffraction (XD) by observation of orientation under surface and magnetic field effects. It was possible to determine the director orientation of uniaxial discotic (N/sub D/) and cylindrical (N/sub C/) samples under surface and magnetic effects by both OM and XD techniques in independent ways. The homologous amphiphilies sodium octil, decil and dodecil sulfate, in powder form, have been studied by Debye-Scherrer technique. Observed reflexions have been indexed and crystallographic parameters determined. Good agreement between calculated and measured densities has been obtained. A crysostat for temperature variation in the interval- 10/sup 0//60/sup 0/ has been constructed, XD diagrams has been obtained for sodium decil sulfate samples allowing determination of phase transitions of two systems. Scattering curves at room temperatures have been obtained in a small-angle X-ray diffractometer. Analysis of profiles allowed determination of short range positional order and correlation ranges. Interference function between scattering objects have been obtained using structural models for the micelles of the uniaxial nematic phases.

10135 (INIS-mf—11860, pp 83-94) **Investigation of hydrogen in some intermetallic systems.** Gonser, U. (Universitaet des Saarlandes, Saarbruecken (Germany, F.R.)). 1986. (In German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88756106/JAW.

In Hydrogen in metals. Results of a point-of-main-effort programme - supported from 1977 to 1985.

10136 (INIS-SU—63, pp 15-23) **Diffuse scattering on the tetrahedral interstitials and Frenkel pairs in a fcc lattice.** Augst, G.R.; Vladislavskij, Yu.I. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780044/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 2(44).

In Physics of radiation injuries and radiation materials technology. Scientific-technical collection.

On the example of tetrahedral interstitial in AHC it is shown,that the presence of interstitial, producing lattice unsymmetrical distortions, in fcc-lattice in diffuse near-Bragg scattering leads to the appearance of the member, which does not depend on the momentum transmitted, apart from normal Huang scattering. Lattice distortion is considered on the basis of lattice statics method. Calculations of distortion field, produced by U/sub 1/-centre in KCl crystal, are carried out. Diffuse scattering on Frankel pairs is considered. It is shown, that near-Bragg diffuse scattering cross-section, averaged by Frenkel pairs configurations, where the vacancy and interstitial are placed at small distances, behaves as q/sup -2/, while averaging by pair configurations, which components are divided at distance of 10 inter-ion intervals, leads to q/sup -4/ cross-section dependence. Besides, in this case oscillations in scattering cross-section are obtained. Calculation of diffuse inter-Bragg scattering for KCl crystal with U/sub 1/-centre and impure Frenkel pair is carried out.

10137 (INIS-SU—67/A, pp 39-41) **Study of /sup 60/Co nuclear spin-lattice relaxation in Pd/sub 99/Fe/sub 1/ and Pt/sub 99/Fe/sub 1/ by the low temperature nuclear orientation method.** Gurevich, G.M.; Erzinkyan, A.L.; Leshtak, L. and others. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

Nuclear spin-lattice relaxation of /sup 60/Co in pd/sub 99/Fe/sub 1/ and Pt/sub 99/Fe/sub 1/ ferromagnetic alloy at 15-25 mK was investigated. The revealed correspondence of relaxation velocities for two alloys testifies to proximity of electron state densities near Fermi boundary as for pure Pd and Pt. 7 refs.; 1 fig.; 1 tab.

10138 **(IPEN-PUB—212) Neutron magnetic multiple diffraction in a natural magnetite crystal.** Mazzocchi, V.L.; Parente, C.B.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 22p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705206/JAW.

Neutron multiple diffraction has been employed in the study of the magnetism in magnetite (Fe/sub 3/O/sub 4/). Magnetite has a crystallographic structure of an inverted spinel with tetrahedral A sites occupied solely by trivalent Fe/sup 3+/ ions and octahedral B sites occupied both by divalent Fe/sup 2+/ ions and the remaining Fe/sup 3+/ ions in random distribution. At room temperature magnetite is a Neel A-B ferrimagnet where the ions on the A, B sites are coupled antiferromagneticaly. This coupling disappears at T sup c approx. or approx.= 580/sup 0/C. Employing a natural single crystal of magnetite experimental neutron multiple diffraction patterns were obtained for the primary reflection 111 at room temperature and 703/sup 0/C. This reflection is almost entirely magnetic in origin resulting in 'Aufhellung' patterns below T/sup c/ and mixed 'Aufhellung-Umweganregung' patterns above T/sup c/. Theoretical patterns were calculated employing the iterative

method for the approximation of intensities by a Taylor series and compared to the experimental results.

10139 (JINR-D—14-87-799, pp 151) **Theory of μ/sup +/ polarization behaviour in solid and liquid hydrogen.** Belousov, Yu.M.; Smilga, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89780035/JAW. (CONF-8706161—).

From 2. international conference on muon and pion interactions in matter; Dubna, USSR (30 Jun 1987).

10140 **(KEK—88-2) XPS and AES studies of thin oxide layers on niobium for superconducting rf cavities.** Asano, Kiyomitsu; Furuya, Takaaki; Kojima, Yuzo and others. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). May 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756073/JAW.

Results from X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) studies of thin oxide layers formed on niobium by surface treatments, which can be applied to superconducting rf cavities, are presented.

10141 (KURRI-TR—299, pp 3-8) **Structural analysis of high-T/sub c/ superconductive oxide by neutron Riedveld method.** Izumi, Fujio. (National Inst. for Researches in Inorganic Materials, Sakura, Ibaraki (Japan)). Jan 1988. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780038/JAW. (CONF-8712131—).

From Specialists' seminar on cristal structurization and pre-phase-transition phenomena by means of neutron diffraction; Kumatori, Japan (11 Dec 1987).

It has been established that the high-T/sub c/ superconductive oxides containing copper are non-stoichiometric compounds of (distorted) K/sub 2/NiF/sub 4/ type crystals and oxygen-deficient triple perovskite type crystals. However, there are still many differences in views among researchers concerning the space groups, deficiency of oxygen atoms, and oxidation state of ions in these high-T/sub c/ superconductive oxides and related compounds. In the present report, major issues on crystal structures are outlined and some comments are presented. A study by convergent electron diffraction has recently shown that the space group of the rhombic La/sub 2/CuO/sub 4-y/ is represented as Cmca. The space groups of the rhombic and tetragonal Ba/sub 2/YCu/sub 3/O/sub 7-y/ crystals have been identified as Pmmm and P/sub 4//mmm, respectively. Unlike K/sub 2/NiF/sub 4/ type superconductors, the y-value of the Ba/sub 2/YCu/sub 3/O/sub 7-y/ type crystals varies widely in the range from 0 to 1. For those with a T/sub c/ around 90 K, the value of y has been suggested by recent studies, including one by the author, to be slightly smaller than 0.1. The dependence of the Cu/sup +/, Cu/sup 2+/ and Cu/sup 3+/ contents on y in Ba/sub 2/YCu/sub 3/O/sub 7-y/ crystals as determined by iodometry is consistent with the conventional mixed Cu valence model. It is stressed, however, that the positive holes that play the key role in superconduction are not simply localized at Cu or O atoms but should be expressed as [Cu-O]/sup +/. (Nogami, K.).

10142 **(KURRI-TR—299) Papers presented at the specialists' seminar on 'cristal structurization and pre-phase-transition phenomena by means of neutron diffraction'.** Shiozaki, Yoichi; Shibuya, Iwao (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jan 1988. Vp. (In Japanese). (CONF-8712131—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780038/JAW.

From Specialists' seminar on cristal structurization and pre-phase-transition phenomena by means of neutron diffraction; Kumatori, Japan (11 Dec 1987).

Papers presented at this meeting have been abstracted and indexed separately.

10143 **(LA-UR—88-3884) Theoretical predictions for side-chain liquid-crystal polymers and comparison to experiment.** Dowell, F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-881155—12). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003578/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

This paper presents results from a new unique microscopic molecular theory for side-chain liquid-crystalline polymers (LCPs) in the nematic (N) and multiple smectic-A (SA) LC phases and the isotropic (I) liquid phase. There are no ad hoc or arbitrarily adjustable parameters in this theory. The agreement between the theoretical and experimental values for various properties (including transition temperatures and quadratic characteristic radii) is very good (relative deviations between 0% and less than 6.2%). The theoretical results also show--for the first time--that the N and I phases for these LCPs involve the packing of plate-like sections of backbones and side chains and that the local bilayer SA phase involves packing of side-chains within a plate-like section. This type of packing is predicted to be typical for side-chain LCPs. This theory can predict--for the first time--whether the side chains of a molecule pack on the same or alternating opposite sides of the backbone and whether side chains on different molecules interdigitate (overlap) with each other. 13 refs., 1 fig., 4 tabs.

10144 **Dynamical simulation of liquid- and solid-metal self-sputtering.** Morgan, W.L. (Joint Institute for Laboratory Astrophysics, National Bureau of Standards and University of Colorado, Boulder, Colorado 80309). *Journal of Applied Physics;* **65**: No. 3, 1265-1269(1 Feb 1989).

Molecular dynamics simulations of self-sputtering are performed using the recent picture [M. P. D'Evelyn and S. A. Rice. J. Chem. Phys. 78, 5081 (1983)] of a stratified liquid-metal surface as a model. These results are compared to those obtained from a liquid model having uniformly distributed atoms and a crystalline solid model. The stratified liquid-metal model shows an enhanced low-energy sputter yield, which falls below those of the other models for ion-impact energies above several hundred electron volts. These results are discussed in light of various published measurements of sputter yields of metals in their liquid and solid phases.

10145 **Scattering of x rays from nonideal multilayer structures.** Stearns, D.G. (Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Journal of Applied Physics;* **65**: No. 2, 491-506(15 Jan 1989).

A general theory is developed for the scattering of x rays from a single nonideal interface between two dielectric media. It is then extended to describe the scattering of x rays from a multilayer structure composed of many nonideal interfaces. The most unique feature of this theory is that there are no constraints on the physical structure of the interfaces; the interfaces can have any form of roughness or compositional inhomogeneity. A simple analytical expression is derived for both the near and far radiation field to first order, assuming that the scattering is weak. The theory is valid for arbitrary polarization and at all angles of incidence (measured from the normal) less than the critical angle for total external reflection. Finally, the results are applied to study the effect of different interface structures on the performance of multilayer x-ray optics.

10146 **Percolation theory for the plastic yield transition.** Tonks, D.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **65**: No. 1, 105-111(1 Jan 1989).

It will be shown how the percolation threshold in a standard continuum percolation model corresponds to the plastic yield transition in a dislocation model with infinitely strong point obstacles and with no dislocation cancellation allowed. The cluster properties of areas defined to be "open" to dislocation loop expansion will be simulated using a lattice model and Monte Carlo methods. The critical exponents $\nu$, $\gamma$, and $\beta$ for these areas will be given. Only the value of $\beta$, the exponent corresponding to the infinite cluster, is the same as that for the standard continuum percolation model.

10147 **High-resolution multiphoton laser-induced fluorescence spectroscopy of zinc atoms ejected from laser-irradiated ZnS crystals.** Arlinghaus, H.F.; Calaway, W.F.; Young, C.E.; Pellin, M.J.; Gruen, D.M.; Chase, L.L. (Materials Science, Chemistry, and Chemical Technology Divisions, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **65**: No. 1, 281-289(1 Jan 1989).

Time-of-flight (TOF) measurements employing high-resolution multiphoton laser-induced fluorescence spectroscopy (LFS) have been used as a probe to determine the yield and velocity distributions of Zn atoms ejected from a ZnS single crystal under irradiation by 308-nm photons. For fluences between 20 and 80 mJ/cm$^2$ (irradiated area 2 mm$^2$), the velocity distributions could be fitted by Maxwell—Boltzmann distributions where the characteristic temperature increased from 2000 to 9000 K, respectively. The absolute neutral Zn yield also increased from $10^9$ to $10^{12}$ atoms per pulse over this same fluence range. Plots of temperature (T) as a function of fluence (F) and yield as a function of 1/T and 1/F suggest thermal evaporation as the mechanism for the Zn emission.The results indicate that with increasing fluence a critical combination of particle density and laser intensity is reached for formation of a plasma which interacts with the surface to cause catastrophic failure. For consecutive laser shots at constant ablation laser fluences, a nearly exponential increase of the Zn particle density was observed, although the measured kinetic temperature remains approximately constant even beyond the onset of visible damage to the ZnS surface. Doppler-shift techniques have been combined with TOF measurements for the first time in order to separate prompt from delayed emission of ablated atoms as well as to probe possible molecular or cluster ejection and fragmentation. Evidence for the latter phenomena was obtained.

10148 **Mean field approach to molecule—surface scattering at finite temperature: Multiphonon theory.** Jackson, B. (Department of Chemistry, University of Massachusetts, Amherst, Massachusetts 01003). *Journal of Chemical Physics;* **90**: No. 1, 140-150(1 Jan 1989).

A theory is presented for the phonon inelastic scattering of molecules from surfaces. Both the molecule and the surface and bulk vibrations of the solid are treated in a fully quantum mechanical fashion. The model includes multiphonon interactions and is thus applicable to both heavy and light gas species at both high and low beam energies. The method is a mean field approach in that both the molecule and the bath are evolved simultaneously and self-consistently. The result is that the molecular wave function obeys a Schroedinger-like equation, but propagates on a gas—surface interaction potential which is both time and temperature dependent. The theory is easily applied to standard zero temperature time dependent scattering techniques, with only a small increase in computer requirements. The model is extended to the specific case of atom—metal scattering. Results are presented for Ne scattered from a Cu(100) surface.

10149 **High-sensitivity plasma-based sputtered neutral mass spectrometry depth profiling of zinc-implanted GaAs.** MacLaren, S.W.; Loxton, C.M.; Sammann, E.; Kiely, C.J. (Center for Microanalysis of Materials, Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 17-20(Jan 1989).

A commercial sputtered neutral mass spectrometer, using a rf-generated plasma for both sputtering and postionization of sputtered particles, has been modified to improve sensitivity for trace analysis. The modified instrument has been used to depth profile zinc-implanted gallium arsenide. A detection limit of 20 ppma was attained for zinc under conditions of maximum depth resolution from an analyzed sample area of 0.2 cm$^2$ with a useful yield of 5 to 7 x 10/sup -10/ . The results have been compared with those of secondary ion mass spectrometry. Sputtered neutral mass spectrometry (SNMS) depth profiles revealed zinc redistribution in one heavily implanted sample, leading to the discovery of unusual structural damage through transmission electron microscopy. This investigation is discussed as an example of the usefulness of the SNMS technique in practical applications.

10150 **Determination of diatomic crystal bond lengths using atomic s-orbital radii.** Zhang, S.B.; Cohen, M.L.; Phillips, J.C. (Department of Physics, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12085-12088(15 Dec 1988).

We develop a theory to determine the bond lengths of over 270 AB crystals having ZnS, NaCl, and CsCl structures, including intermetallic compounds. The first-principles pseudopotential s-orbital radius r/sub s/ is used, which contains no element-specific adjustable parameters. The good agreement found here between the calculated and measured bond lengths, along with the earlier successful applications of orbital radii for separating structures, illustrates the importance and usefulness of the orbital-radii scheme.

10151 **Model for minority-carrier band-gap states in semiconductors.** Mahan, G.D. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830-6032). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12436-12442(15 Dec 1988).

A variational calculation is presented for the energies of electrons and holes which interact with a random distribution of donor impurities in a semiconductor. At high density, smaller band-gap narrowing is predicted for a random distribution than for an ordered one. A new model is presented for the minority-carrier states in the band gap.

10152 **Generalized dynamic-disorder transport rule with application to the study of temporal correlation effects.** Druger, S.D.; Ratner, M.A. (Materials Research Center and Department of Chemistry, Northwestern University, Evanston, Illinois 60208). *Physical Review [Section] B: Condensed Matter;* **38**: No. 17, 12589-12599(15 Dec 1988).

A new relation giving average transport behavior for dynamically disordered systems in terms of that for static disorder follows by considering the statistical growth of mean-square carrier displacement. The result is more widely applicable than the $D(\omega) \rightarrow D(\omega - i\lambda)$ analytic continuation rule (for average reinitialization rate $\lambda$) originally derived for bond percolation on a periodic lattice, and reproduces earlier results in appropriate limits, thereby showing the analytic continuation rule and other earlier results to apply more generally than previously demonstrated, applying for example to a continuous distribution of hopping rates, to nonperiodic arrays of sites, and to site percolation as well as bond percolation. Application to a study of temporal correlation between reinitialization events in a bond-percolation model shows these effects to be small but non-negligible, demonstrating the applicability of the previous analytic continuation rule as a reasonable approximation under conditions where temporal correlation makes it inexact.

10153 **Surface properties of a heavy-fermion system: An exact many-body solution to a periodic-cluster Hubbard model.** Chen, C.; Reich, A.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 18, 12823-12833(15 Dec 1988).

An exact solution of an eight-site crystal model with periodic boundary conditions, a {001} thin film with face-centered-cubic crystal structure, is presented for the case of a heavy-fermion system. The object is to study modifications of the many-body electronic structure in the presence of surfaces. The model consists of (a) a single, fully symmetric orbital per site, with nearest-neighbor and second-nearest-neighbor hopping; (b) an infinite Coulomb repulsion between electrons on the same site; (c) antiferromagnetic superexchange interactions; and (d) a nearly half-filled band ((7/8 electron per site). Two structures are investigated: a two-layer and a four-layer fcc slab. The nature of the change from bulk to surface is studied by introducing a variable coupling between periodically extended slabs. The many-body spectrum, the one-electron occupancy, and the change in properties from bulk to surface are obtained and discussed.

10154 **Inelastic neutron scattering from liquid and solid hydrogen at high momentum transfer.** Langel, W.; Price, D.L.; Simmons, R.O.; Sokol, P.E. (Institut Max von Laue-Paul Langevin, 156 X Centre de Tri, F-38042 Grenoble, France). *Physical Review [Section] B: Condensed Matter;* **38**: No. 16, 11275-11283(1 Dec 1988).

Solid and liquid para-hydrogen and a solid mixture of ortho- and para-hydrogen have been studied by inelastic neutron scattering at momentum transfers from 5 to 30 A/sup -1/. The observed

scattering function can be interpreted in terms of scattering from independent hydrogen molecules using the impulse approximation when internal excitations of the molecules are included. Scattering peaks are observed at the recoil energy, shifted by the energy of the internal rotational transitions, and broadened by the translational motion of the molecules. The peaks can be fitted by Gaussian functions, showing that, to within the accuracy of the measurement, the translational momentum distribution of the hydrogen molecules in the condensed phases has a Gaussian form. The kinetic energy of the para-hydrogen molecules at 1 bar is 76 +- 9 K in the solid at 10 K and 63 +- 6 K in the liquid at 17 K. The kinetic energy for the ortho component in the solid ortho-para mixture is estimated to be the same as for the para solid within the experimental error, although extraction of quantitative information is more difficult because of the complicated spectra.

10155 **Molecular-dynamics method for the simulation of bulk-solid interfaces at high temperatures.** Lutsko, J.F.; Wolf, D.; Yip, S.; Phillpot, S.R.; Nguyen, T. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11572-11581(1 Dec 1988).

A new method for the molecular-dynamics simulation of bulk planar interfaces at high temperatures is presented. The method uses the basic Parrinello-Rahman (constant-stress) scheme, modified for the application to inhomogeneous systems. Since our computational cell contains only one interface with two-dimensional (2D) periodic border conditions, we are able to study isolated interfaces all the way up to melting. The interaction between boundaries which may lead to their annihilation at higher temperatures, which is a problem when 3D periodic borders are applied, is thus avoided. As an application, the method is used to study the stability of a grain boundary at high temperatures. Observations on a possible connection between grain-boundary migration and "premelting" are discussed.

10156 **Algorithm for the simulation of many-electron systems at low temperatures.** White, S.R.; Sugar, R.L.; Scalettar, R.T. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11665-11668(1 Dec 1988).

We present a new algorithm for the numerical simulation of many-electron systems, which is particularly effective for the study of two-dimensional models at low temperatures. We present results for the two-dimensional Hubbard model on lattices as large as 8 x 8 and inverse temperatures as large as $\beta = 10$. As the temperature is lowered, we find a continuous rise in the d-wave pairing susceptibility, indicating the possibility of a phase transition to a superconducting state.

10157 **Molecular-dynamics model for electron transfer at the electrode-electrolyte interface.** Halley, J.W.; Hautman, J. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11704-11710(1 Dec 1988).

We describe a molecular-dynamics model for the calculation of the rate of electron transfer in an outer-shell electron transfer reaction at the electrode-electrolyte interface. The model consists of 216 water molecules in a box together with one iron ion that can be in either its ferrous or its ferric valence state. In previous work we have established the validity of the model for the ion in bulk aqueous solution. Here we report the algorithm for the electron transfer rate which we are using and present results using it. The results are in reasonable accord with experiment, but the calculation is not yet parameter free.

10158 **Scattering properties of solitons in nonlinear disordered chains.** Li, Q.; Soukoulis, C.M.; Pnevmatikos, S.; Economou, E.N. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11888-11891(1 Dec 1988).

The scattering of a soliton from a disordered one-dimensional atomic lattice with nonlinear nearest-neighbor interactions of quartic type is studied numerically. The disorder is of the binary-alloy type with the concentration of the impurity masses m given by p. We numerically find that for large enough lengths L, the soliton transmission coefficient T decays as $1/\sqrt{L}$. This behavior has been obtained also by an analytical study of the transmission of a Gaussian wave packet in a linear disordered system. For short and intermediate lengths, T decays with a different power law for different nonlinear potentials. This behavior can be accounted by a simple independent scattering picture. Finally, the role of the boundary conditions in disordered nonlinear systems is discussed.

10159 **Application of the method of effective potentials to a model for twinning in elastic materials.** Marianer, S.; Floria, L.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and Department of Physics, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 12054-12057(1 Dec 1988).

We extend the method of effective potentials to systems with next-nearest-neighbor interactions, and apply it to a one-dimensional discrete model for twins in elastic materials. The energy of the system is given by H = +(γ/2) (u/sub n//sub +1/-2u/sub n/+u/sub n-1/)² -cosu/sub n/, where the first two terms model the elastic strain-dependent energy which we take to be in the form of a double well in the strains and the third term gives its dependence on the discretized strain gradients. The periodic potential in the last term is introduced to allow for additional interactions with a background such as a parent phase, grain boundaries, or another array of twins. We obtain the phase diagram and show that it consists of various modulated commensurate as well as incommensurate ground-state configurations. We find continuous phonon-driven transitions between the homogeneous and any modulated phase, an incomplete devil's staircase in a narrow region close to the homogeneous phase and first-order soliton-driven transitions between commensurate phases. The first-order transition lines end at triple points where three commensurate phases coexist. In contrast to other nonconvex models we do not find here any superdegenerate points. We give general arguments which exclude the existence of such points in the present model. Preliminary results obtained by driving the system are discussed. These consist of various metastable configurations exhibiting strong hysteretic variation with the driving force.

10160 **Planar channeling in superlattices. II. Catastrophic dechanneling.** Picraux, S.T.; Biefeld, R.M.; Allen, W.R.; Chu, W.K.; Ellison, J.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11086-11097(1 Dec 1988).

We report systematic studies of energetic particle channeling along the inclined (110) crystal planes in a strained-layer superlattice (SLS) under conditions of catastrophic dechanneling. This phenomenon is distinguished by the rapid enhancement in dechanneling after the penetration of several superlattice layers due to a resonance between the channeled particle wavelength and the SLS period. Catastrophic dechanneling conditions are achieved in a (100) GaAs/sub 0.09/P/sub 0.91//GaP superlattice with layers of equal thickness (34 nm) along the inclined (110) planes for a 1.2-MeV $^4$He beam. Due to the alternating tilts at each interface, a rapid increase in the scattering yield to a value close to that for random scattering occurs after penetration of 1—5 superlattice layers, and a strong asymmetric dependence on incident angle is observed. The theoretically predicted depth and angular dependences of the catastrophic dechanneling are calculated by numerically integrating for various initial conditions the differential equation describing planar channeled particle motion in SLS's. A two-parameter, least-squares fit gives excellent agreement between theory and experiment for a tilt angle of Δpsi = 0.153° and a critical impact parameter of r/sub c/ = 1.25a/sub T/. Steps are found in the depth and angular dependence of the catastrophic dechanneling. This structure provides the greatest sensitivity to the relative strain between superlattice layers of any of the ion-channeling methods.

10161 **Applications of a theory of ferromagnetic hysteresis.** Hodgdon, M.L. (Los Alamos National Lab., Los Alamos, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **24**: No. 1, 218(Jan 1988).

The differential equation B = α{vertical} bar H {vertical bar}[f(H) - B] + Hg(H) and a set of restrictions on the material functions f and g yield a theory of rate independent hyseresis for isoperm ferromagnetic materials. A modification based on exchanging the positions of B and H in the differential equation and on allowing for the dependence of the material functions on H extends the theory to rate dependent, nonisoperm materials. The theory and its extension exhibit all of the important features of ferromagnetic hysteresis, including the existence and stability of minor loops. Both are well suited for use in numerical field solving codes. Examples in which the material functions are simple combinations of analytic functions are presented here for MnZn ferrite, NiZn ferrite, NiFe tape, and CoCr thin film. Also presented is a procedure for constructing a two dimensional vector model that yields bell-shaped and M-shaped curves for graphs of the angular variation of the coercive field.

10162 **Basis and consequences of the two-band model for high T/sub c/ oxide superconductors.** Ihm, J.; Lee, D.H. (Seoul National Univ. (Korea)). pp 451-454 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

For high T/sub c/ (La, Y, Rare Earth)-(Sr, Ba)-Cu-O system, the authors propose that two different bands, one with a light mass and the other with a heavy mass, straddle the Fermi level E/sub F/. In $YBa_2Cu_3O_7$, definite evidence exists for this model. In La/sub 2-x/Sr/sub x/$CuO_4$ where band structure calculations give a single d/sub x/2/sub -y²/ band at E/sub F/, this condition is presumably satisfied by lifting of the heavy copper d/sub z²/ band (by electron-electron correlation) to the level of the light copper d/sub x²-y²/ band. This unusual band structure results in not only the interband scattering of the Cooper pair between the d/sub x²-y²/ and d/sub z²/ bands but also the attractive interaction between the partners of the d/sub x²-y²/ electron pair via acoustic plasmon and interband electron-hole pair exchange. Both of these effects are shown to enhance T/sub c/ of the system dramatically.

10163 **Spectra of plasmons in superconducting cuprates.** Ruvalds, J. (Harvard Univ., Cambridge, MA (USA)). pp 455-464 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Plasmons may provide a promising mechanism for superconductivity providing that certain restrictive conditions on the electronic structure are satisfied. However, these favorable situations were presumed to be quit rare until recently, when the exciting discoveries of high temperature superconducting oxides rejuvenated interest in novel mechanisms of superconductivity. An attempt is made to focus on other physical measurements, in addition to the determination of T/sub c/, which may have a bearing on the theoretical proposals. Thus emphasis is placed on the structure which may be observable in the infrared spectroscopy, electron tunneling and neutron scattering whose origin may be traced to an electronic mechanism such as the presence of acoustic plasmons.

10164 **Role of spatial separation in pairing induced by electronic modes.** Gutfreund, H. (Hebrew Univ., Jerusalem (Israel)). pp 465-471 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Three points are elaborated on which distinguish between the coupling of an electron to an electronic excitation mode and the electron-phonon coupling: the question of Migdal's theorem and vertex corrections, the importance of local fields, and the role of the exchange interaction. The latter will be demonstrated for the case of pairing via acoustic plasmons. The discussion of these points leads to an emphasis on the confinement of the electrons of the excitonic medium and those which are expected to form Cooper pairs to non-overlapping orbitals. Such a spatial separation between the two types of electrons is a characteristic feature of the exciton mechanism proposed by Little and Ginzburg, and of the specific models considered by Allender et al and by Davis et al.

10165 **Elementary remarks on high temperature superconductors.** Froelich, H. (Univ. of Liverpool (England)). pp 473 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A brief note is presented concerning some elementary concepts relating to high temperature superconductors. It is shown that the transition temperature can be increased at the expense of the current carrying capacity of the superconductor.

10166 **Polaron effects in high-T/sub c/ oxide superconductors.** Scalapino, D.J.; Scalettar, R.T.; Bickers, N.E. (Univ. of California, Santa Barbara (USA)). pp 475-480 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The authors argue that measurements of the specific heat, static susceptibility, dc and ac conductivity, and thermopower are consistent with a polaron model for normal-state conduction in the high-T/sub c/ superconductors La/sub 2-x/Sr/sub x/CuO/sub 4-y/ and $YBa_2Cu_3O$/sub 7-y/. Strong electron-phonon coupling is also suggested by measurements of elastic constants and thermal Debye-Waller factors. They investigate a model for polaron formation in these systems and a possible mechanism for polaron superconductivity.

10167 **Superconductivity due to negative-U impurities.** Schuettler, H.B.; Jarrell, M.; Scalapino, D.J. (Argonne National Lab., IL (USA)). pp 481-488 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract W-31-109-ENG-38.

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The authors review their recent work on induced superconductivity due to negative-U impurities. Results have been obtained by a new method that combines Monte Carlo simulation with diagrammatic techniques. They discuss their possible relevance for the copper oxide high-T/sub c/ materials.

10168 **Prediction of anisotropic thermopower of La/sub 2-x/M/sub x/$CuO_4$.** Allen, P.B.; Pickett, W.E.; Krakauer, H. (Naval Research Lab., Washington, DC (USA)). pp 489-491 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The band structure of Pickett et al and the rigid band approximation are used to calculate the thermopower tensors s/sub xx/(T) and S/sub zz/(T)₂ for La/sub 2-x/M/sub x/$CuO_4$ where M is Ca, Sr, or Ba. The values of N(epsilon) and v/sub α/(epsilon) come directly from the calculated eigenvalue spectrum, whereas tau(epsilon) requires an additional calculation. If electron-phonon scattering dominates (which provides a reasonable and conservative explanation for the measured rho/sub αα/(T) in samples with linear T-dependence and rrr ≧ 4) then tau(epsilon) is given by 1/tau(epsilon) = 2πλ(epsilon)k/sub B/T/n and λ(epsilon) can be approximated by Σ eta/sub a/(epsilon)/M/sub a/$<$omega²$>$ where eta/sub a/(epsilon) has already been calculated in the rigid muffin tin model. Alternatively, if impurity scattering dominates, one might assume 1/tau(epsilon) α N(epsilon), or possibility 1/tau(epsilon) = const. The results for σ/sub αα/(epsilon) and S/sub αα/(T) for all three models are given. All three models predict moderately large positive (hole-like) behavior of S/sub zz/ and smaller, negative (electron-like) behavior of S/sub xx/.

10169 **Band structure and electron-phonon interaction calculations for proposed high-T/sub c/ superconducting oxides: $MCuO_3$ (M = LA, BA, Cs, Y) in the perovskite structure.** Papaconstantopoulos, D.A.; Boyer, L.L. (Naval Research Lab., Washington, DC (USA)). pp 493-499 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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In an effort to explore these ideas theoretically, electronic band structure calculations were carried out for $MCuO_3$ (M = Cs, Ba, La and Y) in the ideal perovskite structure. Band structure quantities were calculated using the self-consistent APW method in the muffin-tin approximation with a local density approximation for exchange and correlation. From these quantities they determine values for the McMillan-Hopfield parameter eta (total and site decomposed), using the rigid muffin-tin approximation to provide some indication of the strength of the electron-phonon interaction in these idealized systems.

10170 **Character of states near the Fermi level in $YBa_2Cu_3O_7$.** Krakauer, H.; Pickett, W.E. (College of William and Mary, Williamsburg, VA (USA)). pp 501-506 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Whatever the mechanism giving rise to superconductivity in $YBa_2Cu_3O_7$, there seems to be little doubt that it is due to pairing of electron states at the Fermi level E/sub F/. Therefore it is of central interest to investigate the character of the states at and near E/sub F/ and their energy- and real-space distribution. The results of detailed Linearized Augmented Plane Wave calculations of these properties are presented.

10171 **Elementary theory of the properties of the cuprates.** Harrison, W.A. (Stanford Univ., CA (USA)). pp 507-514 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Cuprates have prove to be superconducting at high temperatures. Mattheiss and Yu, Freeman, and Xu have already provided self-consistent LAPW calculations of the bands of $La_2CuO_4$, and Mattheiss has interpreted them in terms of a tight-binding description. A preliminary account is provided of an independent tight-binding analysis which provides a self-contained semiquantitative description of the bands, roughly consistent with those given earlier. It also allows estimates of the other properties of this system. In particular they analyze the vibrational and antiferromagnetic properties, finding in the nonmagnetic metallic state an electron-paramagnon coupling constant which becomes arbitrarily large as one approaches the antiferromagnetic state. It may thus account for the high-temperature superconductivity.

10172 **Mean field approach to double-occupancy induced pairing in oxide superconductors.** Newns, D.M. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY (USA)). pp 515-519 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The double-occupancy induced pairing mechanism (DOM for short) of superconductivity applies to systems with strongly correlated narrow energy bands in which an on-site repulsive electron-electron interaction U plays an important role. If U assumes a large but finite value, thus allowing some double occupation, the possibility that two quasiparticles may scatter into a site together increases their phase space, i.e. lowers their energy, and thus acts as an attractive interaction. This DOM can lead to superconductivity, as has been proposed by the author for heavy fermion systems. A very similar mechanism has been proposed by Anderson and coworkers and taken up by others for oxide superconductors. A theory of heavy fermion superconductivity has been adapted to oxide superconductors, arriving at a theory more general than the Anderson-Hirsch approach which fits much of the available data to within a factor of about two.

10173 **Theoretical model for oxygen vacancy dependence of T/sub c/ in the $YBa_2Cu_3O$/sub x/ system ($6 \leq x \leq 8$).** Herman, F.; Kasowski, R.V.; Hsu, W.Y. (IBM Almaden Research Center, San Jose, CA (USA)). pp 521-529 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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With a view to understanding the relationship between oxygen content, oxygen vacancy ordering, and T/sub c/ in the $YBa_2Cu_3O$/sub x/ system, the electronic structure of these materials has been calculated for x = 6, 7, and 8 using the first-principles pseudofunction method. Employing a simple interpolation scheme, the electronic density of states has been estimated at the Fermi level, N(E/sub F/), for materials containing varying numbers of oxygen vacancies and varying degrees of oxygen vacancy disorder. Adopting a simplified BCS model according to which T/sub c/ depends only on N(E/sub F/), it is shown that T/sub c/ increases monotonically as the oxygen content, x, increases from 6 to 8. Moreover, for a fixed x, the more highly ordered the oxygen vacancies, the higher is T/sub c/. In this paper the essential features of their theoretical model are summarized and used to interpret recent experimental results reported at this conference by Batlogg.

10174 **Complex Hamiltonians: common features of mechanisms for high-T/sub c/ and slow relaxation.** Ngai, K.L.; Rendell, R.W.; Rajagopal, A.K. (Naval Research Lab., Washington, DC (USA)). pp 531-538 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The discoveries of the new ceramic superconductors La/sub 2-x/A/sub x/CuO/sub 4-z/ and $YBa_2Cu_3O$/sub 7-x/ with T/sub c/ of about 40K and 90K respectively have given new impetus to the discussions of high-T/sub c/ mechanisms. The specific mechanism by which electrons lower their energy by pairing in these superconducting ceramics is at issue. Arguments have been given that existing experimental data including the linear specific heats at low temperatures seems to eliminate even some unconventional versions of BCS theory of coupling between electron pairs and phonons, and indicates some models are favored. The possibility should also be considered that the linear specific heat observed at low temperatures in these new high-T/sub c/ materials may contain contributions from excess modes such as two-level-systems.

10175 **Superconductivity due to localized bipolarons in metal-oxide compounds.** Ting, C.S.; Xing, D.Y. (Univ. of Houston, TX (USA)). pp 539-551 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The effect on superconductivity of a wide band of electrons due to localized bipolarons is studied by Nambu's formalism. The bipolarons are from electrons of a narrow d band which interact strongly with local phonons and become localized polarons. In the presence of a small mixing term between the wide band electrons and the localized d electrons, they show that the superconducting transition temperature T/sub c/ of the system can be drastically enhanced. The order parameters, energy gap and specific heat jump at T=T/sub c/ have also been investigated.

10176 **Dilute fermi liquid of heavy polarons in copper oxide superconductors.** Laughlin, R.B.; Hanna, C.B. (Stanford Univ., CA (USA)). pp 553-562 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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A large body of data on the newly discovered copper oxide superconductors points to the existence in these materials of a new type of dilute fermi liquid composed of heavy polarons, which they

believe acquire their mass magnetically. Each polaron is a hole doped into the host material, a Mott insulator, self-trapped in a well, much the way a hole added to an alkali halide is trapped. The polaron is mobile, has a mass m* of approximately 6 electron masses, and has an ionization energy, an upper limit on its binding energy, of approximately 0.15 eV. The fermi energy of the polaron liquid in La/sub 2-x/Sr/sub x/$CuO_4$ with x = 0.15 is roughly 80 meV. The smallness of this energy is unprecedented in the phenomenology of superconductivity and is probably the key to understanding these materials.

10177 **Molecular orbital basis for superconductivity with applications to high-T/sub c/ materials.** Johnson, K.H.; McHenry, M.E.; Counterman, C.; Collins, A.; Donovan, M.M.; O'Handley, R.C.; Kalonji, G. (Massachusetts Institute of Technology, Cambridge (USA)). pp 563-576 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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A real-space molecular-orbital basis for superconductivity has been proposed. It was shown in that paper that the occurrence of superconductivity in a broad range of materials is correlated with the nature of the molecular-orbital topology at the Fermi energy. This topology leads to a formula for the superconducting transition temperature (T/sub c/) which (1) depends on two chemical bond parameters at the Fermi energy, (2) reduces to the well known BCS formula for T/sub c/ at certain limits of these parameters, and (3) produces values of T/sub c/ in remarkable agreement with experiment. This molecular-orbital theory furthermore explains in simple chemical-bonding language why many materials are superconducting, why superconductivity and magnetism are generally complementary phenomena, and why some materials are neither superconducting nor magnetic. Key features of this molecular-orbital model of superconductivity are reviewed. Then it is demonstrated that the theory accurately describes the recently discovered high-T/sub c/ superconductivity in La-Sr-Cu-O and Y-Ba-Cu-O oxides.

10178 **Suppression of high temperature superconductivity by disorder in the resonant valence bond model.** Coffey, L.; Cox, D.L. (Ohio State Univ., Columbus (USA)). pp 577-579 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The recently proposed resonant valence bond (RVB) model for high temperature superconductivity generates a pairing mechanism via the super-exchange interaction between strongly correlated electrons on different sites. The need to consider such an unconventional, electronic pairing mechanism is supported by the lack of a measurable oxygen isotope effect in the 1-2-3 (T/sub c/ = 90K) materials and apparent absence of any mode softening as a function of temperature or doping in the (La/sub 1-chi/, Sr/sub chi/)$_2$CuO/sub 4-y/ alloys. These data cast doubt on any explanation of high transition temperatures relying upon exchange of high frequency phonons associated with the light oxygen atoms. Preliminary considerations are summarized on the suppression of superconductivity by non-magnetic disorder in the RVB model. A brief discussion is presented of the relevance of these results to other proposed theoretical models for high T/sub c/ superconductivity and to some of the recent experimental data.

10179 **Discovery and physics of superconductivity above 90K.** Chu, C.W.; Hor, P.H.; Meng, R.L.; Gao, L.; Huang, Z.J.; Wang, Y.Q.; Bechtold, J. (Univ. of Houston, TX (USA)). pp 581-597 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Great progress has been made in the understanding of the high T/sub c/ compounds. However, many basic problems remain, such as the valence state of Cu ions, the role of +2-Cu ions, interplay between magnetic and superconducting interactions, the exact role of dimensionality, and the mechanisms responsible for the unusually high temperature superconductivity in oxides. Stable and reproducible superconductivity has been ambiguously established only up to the 90-100K range in the class of compounds $ABa_2Cu_3O$/sub 6+$\delta$/ with A = Y, La. Evidence of superconductivity, although strong but plagued by poor stability and poor reproducibility, has been reported at temperatures above 300K. However vague, it is interesting to point out that similar problems existed in the 30K and then 90K-superconductivity prior to the identification of the correct phases. Whether history will repeat is yet to be seen.

10180 **Mixed valence copper oxides, high Tc superconductors: structural study and electron transport properties.** Raveau, B.; Michel, C. (Universite de Caen (France)). pp 599-610 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Perhaps more than hundred papers have been published about the subject of mixed valence copper oxides related to the perovskite since the first signs of superconductivity shown by Mueller and Bednorz in the system Ba-La-Cu-O. The rush in this area of research results from the fact that most of the physicists were convinced that the critical temperature of 23.3K observed for $Nb_3Ge$ was a limit difficult to overcome. Synthesis, crystal chemistry and electron transport properties of the oxides A-La-Cu-O (A = Ba, Sr, Ca) are reported. Recent studies of the second generation of high Tc superconductors, $YBa_2Cu_3O_7$ +/- epsilon are presented.

10181 **Tunneling spectroscopy of novel superconductors.** Gray, K.E.; Hawley, M.E.; Moog, E.R. (Argonne National Lab., IL (USA)). pp 611-625 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Recent discoveries of exciting new superconductors have led to further exciting speculations about novel mechanisms and/or pairing. Tunneling spectroscopy can again play an important role in establishing the applicability of these ideas to specific superconductors. In addition to the traditional role of verifying in detail the electron-phonon coupling through $\alpha^2F$, in many cases the magnitude of the gap compared to the BCS prediction or the crystalline gap anisotropy can reveal direct information about novel mechanisms and/or pairing. Since many of these new materials have only been available as bulk samples, or bulk single-crystal studies are desired, the technique of vacuum tunneling spectroscopy, pioneered by Poppe (1981) for superconductors, is most appropriate. However, thick, nonconducting surface layers are often found which prevent true vacuum tunneling. For these samples, mechanical contact of the tunneling tip is required to break through the surface layer to the superconductor below. The resulting point-contact tunneling can, however, emulate many of the results of true tunneling through a vacuum or insulator. In this paper, they shall briefly review relevant tunneling techniques and some recent experiments on magnetic, organic, heavy fermion and high-T/sub c/ oxide superconductors. Connections are made to theoretical ideas, especially regarding novel mechanisms and/or pairing.

10182 **Thermodynamic critical field of $Y_1Ba_2Cu_3O_7$.** Finnemore, D.K.; Fang, M.M.; Clem, J.R.; McCallum, R.W.; Ostenson, J.E.; Ji, L.; Klavins, P. (Iowa State Univ., Ames (USA)). pp 627-632 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract W-7405-ENG-82.

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The thermodynamic critical field curve has been measured for $Y_1Ba_2Cu_3O_7$ close to the superconducting transition temperature in order to determine the magnitude of the specific heat jump at the transition. The slope of the critical field curve is found to be 165 Oe/K, which corresponds to a specific heat jump of 680 mJ/molCuK. If the BCS theory applies, this would also imply a density of electronic states of 3.39 states per electron volt-unit cell and the Sommerfeld term, $\gamma$=5.3 mJ/molCuK$^2$.

10183 **Microstructure and superconductivity in high T/sub c/ materials.** McCallum, R.W.; Shelton, R.N.; Noack, M.A.; Verhoeven, J.D.; Swenson, C.A.; Damento, M.A.; Gschneidner, K.A. Jr.; Gibson, E.D.; Moodenbaugh, A.R. (Iowa State Univ., Ames (USA)). pp 633-645 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract W-7405-ENG-82;AC02-76CH00016.

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This paper considers a number of aspects relevant to the preparation and superconducting properties of high purity $YBa_2Cu_3O_7$. Evidence for the incongruent melting of the material and its implications for producing large grained samples are discussed. Thermal expansion data for a sintered sample is presented and preliminary measurements on single crystalites are given.

10184 **Copper oxidation states, vacancy ordering and their effect on high temperature superconductivity.** Schuller, I.K.; Hinks, D.G.; Jorgensen, J.D.; Soderholm, L.; Beno, M.; Zhang, K.; Segre, C.U.; Bruynseraede, Y.; Locquet, J.P. (Argonne National Lab., IL (USA)). pp 647-652 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract W-31-109-ENG-38.

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A comprehensive review is conducted on high temperature oxides which are isostructural with $YBa_2Cu_3O_{7-\delta}$. X-ray and neutron diffraction, together with superconductive and normal state measurements show that the Cu-O chains present in the structure play an important role in the superconductivity. Whether the oxygen ordering or the presence of copper in a $3^+$ oxidation state is responsible for the high temperature superconductivity cannot be ascertained at the present time.

10185 **X-Ray absorption studies of La/sub 2-x/(Ba,Sr)/sub x/$CuO_4$ superconductors.** Tranquada, J.M.; Heald, S.M.; Moodenbaugh, A.R.; Suenaga, M.; Garrett, R.F.; Johnson, E.D.; Kneedler, E.; Williams, G.P. (Brookhaven National Lab., Upton, NY (USA)). pp 753-754 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The unoccupied densities of states in La/sub 2-x/(Ba,Sr)/sub x/CuO/sub 4-y/ for x = 0.0-0.3 have been studied by measuring x-ray absorption near edge structure (XANES) at the Cu K, La L, and O K edges. From a comparison with several reference materials and taking into account recent cluster calculations on copper complexes, they find that the copper ions have an integral 3d configuration (2+ valence) independent of dopant concentration. Variations in white line intensities observed at La $L_2$ and $L_3$ edges indicate that the density of empty states having d-symmetry with respect to the La site increases with doping. The extra empty states are assumed to be holes in the O 2p band. Changes near the quadrupole feature at the Cu K-edge are consistent with linear combinations of O 2p holes having d-symmetry with respect to the Cu site. Measurements at the O K edge indicate that the edge shifts to higher energy with increasing x as would be expected for a reduction in 2p charge.

10186 **Photoemission studies of the high T/sub c/ superconductor $YBa_2Cu_3O$/sub 9-$\delta$/.** Johnson, P.D.; Qiu, S.L.; Jiang, L.; Ruckman, M.W.; Strongin, M.; Hulbert, S.L.; Garrett, F.R.; Sinkovic, B.; Smith, N.V.; Cava, R.J.; Jee, C.S. (Brookhaven National Lab., Upton, NY (USA)). pp 755-756 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

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VUV photoemission spectra of the valence bands of the high-T/sub c/ superconductor $YBa_2Cu_3O$/sub 9-$\delta$/ $\delta$ = 2.1, have been measured using the UV undulator (beam line U5U). Photon energies h nu = 45.0 eV and 52.0 eV lie within the first harmonic flux output from the undulator, while h nu = 105.0 lies within the second harmonic. the spectra at h nu = 21.2 eV and 40.8 were taken using a He resonance lamp.

10187 **Muon spin relaxation studies on high-T/sub c/ superconductors.** Kossler, W.J.; Kempton, J.R.; Moodenbaugh, A.; Opie, D.; Schone, H.; Stronach, C.; Suenaga, M.; Uemura, Y.J.; Yu, X.H. (College of William & Mary, Williamsburg, VA (USA)). pp 757-758 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

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The AGS proton synchrotron at Brookhaven National Laboratory facilitates a medium-intensity polarized muon channel. Muon spin relaxation ($\mu$SR) experiments on single-phase specimens of (La/sub 1.85/Sr/sub 0.15/)$CuO_4$ and $YBa_2Cu_3O_7$ have been carried out at this facility. In transverse-field $\mu$SR measurements with external magnetic field (500 - 1000 G) applied perpendicular to the initial muon spin direction, the magnetic-field penetration depth $\lambda$ in the superconducting state has been determined. The observed relaxation rate was very small above Tc, while it increased rapidly with decreasing temperature below Tc in the both systems. Comparing the observed values of $\langle \Delta H_3 \rangle$ with a model simulation for the field distribution, the penetration depth $\lambda$ was determined.

10188 **Inductive transition of $YBa_2Cu_3O$/sub 7-$\delta$/ in the 4 MHz frequency range.** Corderman, R.R.; Wiesmann, H.; Ruckman, M.W.; Strongin, M. (Brookhaven National Lab., Upton, NY (USA)). pp 759-761 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

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The inductive transition of superconducting $YBa_2Cu_3O$/sub 7-$\delta$/ was investigated at 4 Mhz. These measurements provide a value of the London penetration depth, $\lambda$/sub L/(0), in $YBa_2Cu_3O$/sub 7-$\delta$/ which differs by a factor of $\approx$ 10 from the value obtained from muon spin relaxation measurements. This discrepancy may be related to the granular nature of this superconductor.

10189 **Intrinsic critical current and magnetization of $YBa_2Cu_3O_7$.** Ghosh, A.; Suenaga, M.; Moodenbaugh, A. (Brookhaven National Lab., Upton, NY (USA)). pp 762-763 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

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In order to investigate the factors which influence the values of J/sub c/ in these oxides, the magnetization was measured for a number of well-characterized specimens of $YBa_2Cu_3O_7$. All of the specimens were prepared by grinding appropriate amounts of the oxides and heat treating them in air or an oxygen atmosphere. T/sub c/ was measured by both inductive and resistive techniques. Powder x-ray diffraction techniques and optical microscopy were used for phase identification and measurements of grain size. Magnetization at 4 K was measured for bars and disks of the sintered materials as well as for ground powders.

10190 **Effect of anisotropy in H/sub c2/ on the breadth of the resistive transition of polycrystalline $YBa_2Cu_3O$/sub 7-x/ in a magnetic field.** Welch, D.O.; Suenaga, M.; Asano, T. (Brookhaven National Lab., Upton, NY (USA)). pp 764-766 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC02-76CH00016.

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To investigate the anisotropy of the upper critical field of polycrystalline $YBa_2Cu_3O$/sub 7-x/ and $La_2CuO_4$-based superconductors. The resistive transition of polycrystalline $YBa_2Cu_3O$/sub 7-x/ was measured in the temperature range 83-93K in magnetic fields up to 25 T and the results were analyzed using the Ginzburg-Landau theory for the H/sub c2/ of axially symmetric supercon-

ductors, together with a percolation theory of the resistivity, to obtain a measure of the anisotropy ratio R identical with H/sub c2 parallel to//H/sub c2/, where parallel to and denote, respectively applied fields parallel and perpendicular to the copper-oxygen layers.

10191 **Photoemission study of high T/sub c/ oxides.** Mueller, D.; Shih, A.; Toth, L.E.; Osofsky, M.; Wolf, S.A.; Kurtz, R.L.; Stockbauer, R.L. (Naval Research Lab., Washington, DC (USA)). pp 829-838 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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To aid in the development of a better understanding of the electronic structure in ceramic compounds reported to superconduct in excess of 35 K of materials, examined changes in the electronic density of states were examined for $YBa_2Cu_3O$/sub x/ with oxygen content via ultraviolet photoelectron spectroscopy. Samples with x = 6.95, 6.5, and 6.05 were examined.

10192 **Electronic states in high Tc oxide superconductors.** Uchida, S.; Takagi, H.; Hasegawa, T.; Kishio, K.; Tajima, S.; Kitazawa, K.; Fueki, K.; Tanaka, S. (Univ. of Tokyo (Japan)). pp 855-870 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Although quite numerous experimental data have been accumulated for oxide superconductors, it is still far from clear why Tc is so high in the Cu-oxides and what is the role of the rare earth and the alkaline earth elements which decorate the Cu-O framework and are not involved in the states near the Fermi level. To these basic questions or to the question of which theoretical models best approximate the actual situation, the experiments so far have given no definite answer. The experimental results are summarized, going back to another oxide superconductor $Ba(Pb,Bi)O_3$. The features of these oxides are described with these oxides and what is special about the Cu oxides is noted. A characteristic feature of the $ABO_3$ perovskite related structure is the feasibility of making the substitutional solid solutions for both A and B site cations over wide compositional range and of producing oxygen-deficient structures. So a systematic study was possible to see the change of the properties with the composition of the substituted elements for BaPb/sub 1-x/Bi/sub x/$O_3$ and (La/sub 1-x/Sr/sub x/)$_2CuO_4$ and with the amount oxygen vacancies for $YBa_2Cu_3O$/sub 7-y/.

10193 **Trends and future: theory.** Cohen, M.L. (Lawrence Berkeley Lab., CA (USA)). pp 1095-1104 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract AC03-76SF00098.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A discussion is presented of theoretical approaches which may be appropriate for explaining the properties of high transition temperature superconductors. The focus is on models and proposals discussed at this conference.

10194 **Trends and future - as seen at the Berkeley workshop.** Geballe, T.H. (Stanford Univ., CA (USA)). pp 1105-1110 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Some of the highlights of the meeting are presented. It was possible to absorb only a small fraction of what went on. The time constraints imposed by the publications committee - which are quite proper for the rapidly progressing field - make it impossible to attempt to be more complete. The author apologizes for neglecting important work. (Also, there is no adequate way to reference the material in this camera-ready manuscript; hence he will quote the talks by the name of the speaker and the group represented. In many cases the work was presented at a poster session. The purpose of referencing it here with the name of the speaker is simply to enable the reader to trace the paper in these proceedings, and definitely is not intended to slight the real authors.) As to the future - that's easy! The key experiments will be done, and the relevant models will survive. He happens to believe that the delicate balance between magnetism and superconductivity in the prototype compound, $La_2CuO_4$ - which can be changed from an antiferromagnet to a superconductor by doping on the La sites as discovered by J.G. Bednorz and K.A. Mueller, or by (presumably) removing a few oxygen vacancies [J.M. Tarascon, Bellcore] - is symptomatic. But it is up to future experiments to tilt the delicate balance and to observe what happens. The substantial progress in the preparation of ceramic samples, single crystals and thin films which is discussed below is encouraging.

10195 **Concluding remarks.** Kresin, V.Z. (Lawrence Berkeley Lab., CA (USA)). pp 1111-1112 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Closing remarks are made concerning the International Workshop on Novel Mechanisms of Superconductivity. It is suggested that a theory to explain the high T(sub-c) should be coming soon if the spate of activity in the experimental arena can be considered an indicator. It is noted that for the new materials the energy gap, the characteristic phonon frequency, and the Fermi energy are comparable. This quantitative similarity is distinctly different from previously known superconducting materials.

10196 **Novel superconductivity.** Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). 1153p. (CONF-870682—). Plenum Publishing Corp., 233 Spring Street, New York, NY 10013.

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The International Workshop on Novel Mechanisms of Superconductivity was held June 22-26, 1987 in Berkeley, California. It was initially conceived to be an experimental and theoretical exploration of the evidence for exotic, non-phononic superconductivity. Its size and scope were changed as a result of the discovery of high temperature oxide superconductors. The broad categories of the conference were: (1) conventional systems, (2) organic superconductors, (3) heavy fermions, (4) high T-sub(c) oxides: general properties, (5) theories of high T-sub(c), and (6) research on high T-sub(c) superconductivity.

10197 **Rocky road to high temperature superconductivity.** Edelsack, E.A.; Gubser, D.U.; Wolf, S.A. (Naval Research Lab., Washington, DC (USA)). pp 1-8 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Early reports of high temperature superconductivity are an interesting part of the story of high temperature superconductivity. They set the stage for the discovery which was to come in 1986. The early results and their lack of confirmation had led many scientists to treat such reports as coming from scientists who were more interested in gaining fame than in doing creditable scientific research. It is noteworthy that the authors of the first reproducible report waited many months to publish their original discovery, due primarily to this climate of distrust for such reports. It is a credit to them and to those who immediately recognized the importance of their announcement that rapid advancement has occurred in the understanding of these materials.

10198 **Superconductivity in thin films of Au/Si by ion implantation.** Jisrawi, N.; McLean, W.L.; Stoffel, N.G. (Rutgers, The State Univ. of New Jersey, Piscataway (USA)). pp 29-38 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Gold films on silicon substrates have been implanted with ions of Si, Ar, and Xe at tens of keV for the purpose of studying

metastable phases inaccessible by other means of preparation. The recent prediction and discovery of superconductivity in the high-pressure hexagonal phases of silicon has called into question previous possible explanations of superconductivity in the Au/Si system.

10199 **Superconductivity and metal clusters.** Knight, W.D. (Univ. of California, Berkeley (USA)). pp 47-50 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

It has been generally accepted that there must be some lower particle size limit below which superconductivity does not occur. However, the idea has not been adequately tested in the size range which is now possible for the production and study of metal microclusters containing from two to two hundred atoms per cluster. Further exploration of the question of the superconductivity of metal clusters deserves consideration, and some experimental approaches are suggested.

10200 **Proximity effect and Anderson localization.** Fukuyama, H. (Univ. of Tokyo (Japan)). pp 51-60 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Proximity effect of interacting electrons in dirty two-dimensional metals is theoretically examined in view of the recent achievement of MOS type three-thermal Josephson junction devices. It is shown that both the amplitude and the coherence length of the Cooper pair propagator are affected by the combined effects of mutual Coulomb interaction and randomness.

10201 **Bounds on superconducting properties in Eliashberg theory.** Carbotte, J.P. (McMaster Univ., Hamilton, Ontario (Canada)). pp 73-82 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The author establishes bounds on some of the properties of an Eliashberg superconductor. It is shown that the normalized specific heat jump at T/sub c/ and the thermodynamic critical field deviation function, are bounded above by a value not much greater than is observed in some known superconductors. Also, a lower limit exists for the dimensionless ratio $\gamma(0)$ T/sub c/ $^2$H/sub c/ $^2(0)$. Here $\gamma(0)$ is the Sommerfeld constant, T/sub c/ is the critical temperature and H/sub C/(0) the zero temperature thermodynamic critical field. On the other hand, the ratio of twice the gap edge to T/sub c/ can rise to 11.5 and the reduced upper critical magnetic field in the clean limit to 1.5. Finally, some results are presented for the very strong coupling limit by which they mean that T/sub c/ is taken to be comparable in size to a typical phonon energy.

10202 **Disorder-Induced pair breaking in superconductors.** Lemberger, T.R.; Lee, S. (Ohio State Univ., Columbus (USA)). pp 83-84 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

By enhancing thermal supercurrent fluctuations, disorder can cause significant pair-breaking effects on the transition temperature, density of states, and order parameter in superconductors. This pair-breaking mechanism in two-dimensional A ell films has been observed by using a novel tunneling technique. A crude model explains the results rather well. An extension to 3 dimensions of that model is used below to estimate pair-breaking rates in Heavy-Fermion and High-T/sub c/ compounds. The disorder-induced pair-breaking rates are likely to be significant.

10203 **Electronic band structure and point-contact spectroscopy of the organic superconductor $\beta$-(BEDT-TTF)$_2$I$_3$.** Weger, M.; Kubler, J.; Schweitzer, D. (Hebrew Univ., Jerusalem (Israel)). pp 149-157 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The authors carried out an ab-initio self-consistent electronic band structure calculation for (ET), using the ASW method. In the present case, there are 55 atoms in a unit cell with P anti 1 symmetry i.e. 28 atoms are inequivalent. In addition, 32 empty spheres were used to fill-up the space between the atoms (60% of the total volume). The question of which phonons play the most important role in superconductivity can be investigated experimentally using the techniques of tunneling and point-contact spectroscopy to determine the Eliashberg function $\alpha^2$(omega)F(omega). The authors used point-contact spectroscopy to determine the Eliashberg function, as well as tunneling to determine the superconducting gap.

10204 **Origin of pairing interaction in organic superconductors.** Bourbonnais, C. (Universite de Sherbrooke, Quebec (Canada)). pp 159-170 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A problem of great importance in the study of organic conductors is the characterization of the microscopic conditions giving rise to superconductivity in these compounds. Looking at the phase diagram of the Bechgaard salts series (TMTSF)$_2$X (X = $PF_6$, $AsF_6$, $ClO_4$,...), this problem seems to be intrinsically linked to the puzzling proximity between superconducting and antiferromagnetic long range order. The existence of antiferromagnetism and the absence of a Peierls transition is known to be a strong indication in favor of dominant repulsive interactions among electrons. This has been used to challenge the traditional role played by phonons in the superconductive pairing interaction and to infer a participation of electron spin correlations in the pairing mechanism. The microscopic origin of this proximity is clarified, especially the mechanism is specified by which antiferromagnetism is itself stabilized and the extent to which it can exert an influence on the metallic state where the pairing interaction is formed. More specifically, implications are presented of recent calculations for the quasi-1D electron gas model.

10205 **Heavy-Electron superconductivity.** Ott, H.R. (Laboratorium fuer Festkoerperphysik, Zuerich (Switzerland)). pp 187-200 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

A brief review of properties of heavy-electron superconductors is given. Especially emphasized are indications for unconventional superconductivity in these materials.

10206 **Heavy fermion properties and their relation to electronic band theory.** Pickett, W.E. (Naval Research Lab., Washington, DC (USA)). pp 233-242 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Some aspects are discussed of modern band theory treatments of heavy fermion (HF) compounds and identifications is made of what they do, and do not, describe about heavy fermion behavior. To this end it is useful to compare to and contrast with the other main theoretical approach, that of parameterized model Hamiltonians. These two approaches are essentially distinct and complementary, and one of the recent trends has been to form a combined, or hybrid, attack by incorporating some features of both.

10207 **Phenomenology of superconductivity and magnetic order in heavy Fermi liquids and narrow-band metals.** deLong, L.E. (Univ. of Kentucky, Lexington (USA)). pp 253-264 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—). Contract W-31-109-ENG-38.

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Trends for the occurrence of superconductivity and magnetic order in narrow-band metals are reviewed. Magnetic interactions and strongly nonadiabatic coupling between electrons and the lattice are discussed as important limitations on the superconducting transition temperature T/sub c/. The quantitative influence of the temperature and magnetic field dependences of normal state parameters on the upper critical field of heavy fermion and high-T/sub c/ superconductors, including the novel very-high-T/sub c/ copper oxides, are considered. Recent evidence is reviewed for the existence of an unexpectedly low energy scale T/sub o/ that acts as a hyperstrong cutoff for the T/sub c/ of heavy fermion, A15 and other narrow-band superconductors.

10208 **Proximity effects between conventional and unconventional superconductors.** Millis, A.J.; Rainer, D.; Sauls, J. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 265-273 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Recent theoretical work on the possibility of using tunneling and proximity effect experiments to study unconventional superconductors is reviewed. The basic idea is simple: a thin layer of some well understood conventional superconductor is placed in good metallic contact with the superconductor of interest, and then (e.g. by tunneling at the outer edge of the conventional layer) how the superconducting properties of the conventional material are altered by its proximity to the unconventional material is measured. To study this question theoretically one has to solve the gap equation for the inhomogeneous system. Because the symmetry and the physical origin of the pairing interaction may be different for conventional than for unconventional superconductors, it is possible that the proximity effect is different between two conventional superconductors than it is between a conventional and an unconventional superconductor. Understanding of the nature and observability of these differences is still preliminary.

10209 **Charge imbalance relaxation as a probe of anisotropic heavy fermion superconductors.** Coffey, L.; Lemberger, T.R. (Ohio State Univ., Columbus (USA)). pp 275-277 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Quasiparticle charge imbalance in the heavy fermion superconductors $UBe_{13}$ and $UPt_3$ is the subject of this calculation. tau/sub R/(T) and R(T) are calculated using the polar and axial order parameters of superfluid $^3He$ as generic models for the order parameters that have been proposed for the heavy fermion compounds. The primary pairbreaking mechanism contributing to tau/sub R/(T), other than 1/tau/sub TUN/, is quasiparticle scattering from non-magnetic disorder. Results for tau/sub R/(T) and R(T) for the polar case are presented and discussed.

10210 **Ginzburg criterion in high T/sub c/ oxides.** Deutscher, G. (Tel Aviv Univ. (Israel)). pp 293-294 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The application of the Ginzburg criterion yields for the new high T/sub c/ oxides a broad critical region, with a width of order unity. This width could be reduced in the event of large strong coupling corrections.

10211 **Electronic fluctuation and pairing.** Ashcroft, N.W. (Cornell Univ., Ithaca, NY (USA)). pp 301-308 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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From one-electron theory it is argued that a starting point for a description of the electronic structure of the high T/sub c/ compounds is a set of almost filled bands separated by a significant gap from unoccupied bands. But it is also argued that correlation effects are important, and these are included by separating the electronic charge into itinerant and quasilocalized, the latter possessing polarization-waves of exciton character that provide a pairing mechanism for the electrons. It is also suggested that for low enough densities fluctuation effects in the itinerant electrons may significantly modify the standard averaged repulsive contribution to the total pairing interaction.

10212 **Interactions at interfaces in layered systems.** Arnold, G.B. (Univ. of Notre Dame, IN (USA)). pp 323-331 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Artificially layered systems have received a great deal of attention in recent years. One major impetus for the study of such systems was the search for alternative mechanisms of superconductivity. The discovery of superconductivity above nitrogen temperature in a naturally layered system has elevated the awareness of the potentially wide range of properties available in layered systems, and renewed the interest of theorists in alternative mechanisms of superconductivity connected with interactions between layers. The system which is discussed in this article consists of two types of layers, weakly-coupled to each other. In one layer, electronic motion parallel to the interface is of the nearly free type in a two dimensional band which is only partially full. In the other layer, at energies near the Fermi Energy, there is an energy gap, so that there are no states which freely propagate parallel to the interface in this layer. The electronic overlap integral between states in these layers, T, is assumed to be small relative to overlap integrals within each layer. The failure to observe the exchange coupling of electrons in the conducting layer to singlet particle-hole excitations in the neighbori..g layer may have been due in part to a generic instability related to phonons at interfaces, which is discussed in the first portion of this article. The second portion deals with interactions between two weakly-coupled layers, and the proposed mechanism for superconductivity.

10213 **Excitonic superconductivity in layer structures.** Bardeen, J.; Ginsberg, D.M.; Salamon, M.B. (Univ. of Illinois, Urbana (USA)). pp 333-339 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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Thermodynamic and magnetic evidence on the 90K compounds - copper oxide compounds, based in part on work done at Illinois on measurements of the specific heat jump at T/sub c/ are discussed. The thermodynamic data are consistent with BCS in the weak coupling limit. The superconductors are strongly type II, with a small Pippard coherence distance, zeta/sub o/ $\sim 10^{-7}$ cm and a penetration depth $\lambda \sim 10^{-5}$ cm. This agreement supports the BCS quasiparticle excitation spectrum and appears to rule out theories in which pairs are present in the normal state and undergo a Bose transition to a superfluid condensate. A qualitative discussion is given of the exciton mechanism and of possible excitonic transitions that might be responsible for the attractive interaction. A discussion is given of experiments that might help distinguish between the various suggests that have been made. An important question is whether or not collective excitations (plasmons, acoustic plasmons, spin waves) are involved.

10214 **Exciton interaction: its possible role in high temperature superconductivity.** Little, W.A. (Stanford Univ., CA (USA)). pp 341-353 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The recent remarkable developments in superconductivity has forced the group of physicists in the main stream of superconductivity research to re-examine the possible role of what has been referred to in the conference as novel mechanisms of superconductivity. The exciton mechanism is one such. While the many studies and developments in this subject are relatively well known to those involved in studies of organic superconductors and superconductors of reduced dimension, it appears that it is not well known to that

large body of physicists involved in the more conventional mainstream of superconductivity. The salient features of the mechanism are reviewed and what it can and cannot do is discussed. Remarks are based on the most recent and most comprehensive review of the subject published in 1979, plus a few key papers since that time.

10215 **Charge transfer resonances and superconductive pairing in the new oxide metals.** Varma, C.M.; Schmitt-Rink, S.; Abrahams, E. (AT & T Bell Labs., Murray Hill, NJ (USA)). pp 355-365 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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All theoretical discussions of the superconductivity in the new oxide metals have been within the BCS framework of two-particle pairing. The issue in question is what is the pairing mechanism? Do the Cooper pairs have the usual BCS s-wave symmetry? is the pairing so strong that the Blatt-Schafroth type ideas of Bose condensation of tightly bound pairs are realized? The points of view proposed may be classified as follows: (I) pairing through electron-phonon interactions (i) conventional, (ii) bipolaron formation and Bose condensation; (II) pairing through magnetic correlation of the electrons (i) exchange of antiferromagnetic (AFM) spin fluctuations, (ii) resonating valence bond (RVB) or spin-bipolaron formation and Bose condensation; (III) pairing through exchange of electronic polarization resonances.

10216 **Bonds, bands, charge transfer excitations and superconductivity: $YBa_2Cu_3O$/sub 7-δ/ vs $YBa_2Cu_3O_6$.** Yu, J.; Freeman, A.J.; Massidda, S. (Northwestern Univ., Evanston, IL (USA)). pp 367-372 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

It is generally recognized that highly precise electronic structure calculations provide important information about the properties of the superconducting materials and provide insight into the possible mechanism for their observed high temperature superconductivity. Some results for the Y-Ba-Cu-O materials are presented focusing on the role of chains vs planes in terms of state-of-the-art all-electron local density calculations for $YBa_2Cu_3O$/sub 7-δ/ (the high T/sub c/ superconductor with chains and planes) and for $YBa_2Cu_3O$/sub 6+x/ (planes but no chains and no superconductivity). The results obtained highlight the role of charge transfer excitations (exciton) proposed earlier for the high T/sub c/ in $YBa_2Cu_3O$/sub 7-δ/.

10217 **Excitonic model for the new high temperature superconductors.** Collins, T.C.; Kunz, A.B.; Ladik, J.J. (Univ. of Tennessee, Knoxville (USA)). pp 379-384 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

An excitonic model is given which can explain the experimental results of the new high temperature superconductors, AB/sub $4_2$/$CU_3O$/sub 6+δ/ (A = La, Nd, Sm, Eu, Gd, Ho, Er, Lu and Y). The excitonic model is an extension of the one used to describe the temperature-dependent surface shielding effect in Cu and the anomalously large diamagnetism measurements found in CuCl and CdS at temperature above that of liquid nitrogen. Both singlet and triplet paired spins are included in the description. The parallel paired states contribute a paramagnetic term to the susceptibility and make possible no change in T/sub c/ with magnetic ion replacements for Y.

10218 **Excitonic theory of high temperature oxide superconductors and the lack of an isotope shift.** Gallo, C.F.; Whitney, L.R.; Walsh, P.J. (Fairleigh-Dickinson Univ., Teaneck, NJ (USA)). pp 385-394 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The high temperature superconductivity observed in $Y_1Ba_2Cu_3O_7$ is analyzed in terms of the phonon + exciton theory of Allender, Bray and Bardeen (ABB) applied to an atomically microscopic interfacial model of this anisotropic layered material. An approximate equation is presented that is conceptually transparent and allows one to visualize the relative interplay between the exciton and phonon contributions. Recent data on the lack of an isotope shift on the transition temperature of $Y_1Ba_2Cu_3O_7$ is analyzed. The equation gives conditions for a lack of an isotope shift when the exciton mechanism dominates over the phonon mechanism. From ABB theory, numerical calculations are presented that demonstrate the plausibility of a dominant exciton mechanism in $Y_1Ba_2Cu_3O_7$. It will be very interesting to perform the isotope experiment on other oxide superconductors to further explore the possibility of excitonic superconductivity indicated by their calculations. Superconducting transition temperatures near room temperature appear attainable at reasonable carrier densities and within ABB's excitonic theory and their data extrapolations.

10219 **Superexchange mediated superconductivity in the single band Hubbard model.** Doniach, S.; Hirschfeld, P.J.; Inui, M.; Ruckenstein, A.E. (Stanford Univ., CA (USA)). pp 395-399 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The authors discuss the physics of BCS pairing in the strongly correlated single band Hubbard model close to half-filling. In contrast to spin-fluctuation mediated pairing of importance in $^3$He and heavy Fermion systems, they argue that the superexchange mediated pairing proposed by Anderson is stabilized by short range antiferromagnetic spin ordering. A mean field calculation shows that coexistence of antiferromagnetism and superconductivity is a stable solution for a doped Mott-Hubbard system.

10220 **Spin-Density wave state in (La/sub 1-x/M/sub x/)$_2$CuO/sub 4-δ/.** Hasegawa, Y.; Fukuyama, H. (Univ. of Tokyo (Japan)). pp 401-405 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The Fermi surface instability in quasi-two-dimensional electrons is investigated as a possible model of oxides superconductors, (La/sub 1-x/M/sub x/)$_2$CuO/sub 4-δ/. The spin density wave (SDW) transition temperature within the mean field approximation is obtained as a function of band filling. It is found that SDW is stable only in a small region around the half filling of the band.

10221 **Critical temperature of superconductivity caused by strong correlations.** Fukuyama, H.; Hasegawa, Y.; Yosida, K. (Univ. of Tokyo (Japan)). pp 407-410 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

Detailed numerical calculations have been performed of the critical temperature of superconductivity caused by strong correlations based on the mechanism of Anderson combined with the coherent-potential approximation. The results confirm their former approximate estimate of the carrier number dependence.

10222 **Superconducting energy gap and pairing interaction in high T/sub c/ oxides.** Maekawa, S.; Ebisawa, H.; Isawa, Y. (Tohoku Univ., Sendai (Japan)). pp 411-419 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

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The authors propose two characteristic features in high T/sub c/ oxides, La-Sr-Cu-O and Y-Ba-Cu-O: (i) the apparent discrepancy of the superconducting energy gap between far-infrared and quasi-particle tunneling measurements can be an indication of anisotropic Cooper pairing with spin singlet; (ii) the Coulomb interaction induces spin wave mode with the wave number of the Brillouin

zone boundary and the energy close to $2\Delta_0$, $\Delta_0$ being the maximum value of the superconducting energy gap. This mode may be observed by neutron inelastic scattering and tunneling experiments.

**10223 Are spin density waves involved in high-temperature superconductivity?.** Fenton, E.W. (National Research Council of Canada, Ottawa, Ontario). pp 421-428 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

It appears that the question of whether or not an electron density wave occurs, and whether it is a charge density wave (CDW) or a spin density wave (SDW), is probably important to understanding just why T/sub c/ has increased from less than 24 K to a present maximum of 100 K for $Y_1Ba_2Cu_3O$/sub y/ and probably much higher values in the future. At the time of this writing, there are many rumors that antiferromagnetism has been verified in lanthanum and one-two-three compounds by neutron scattering experiments, but no preprints yet exist on this, and moreover it is not known whether the antiferromagnetism, if it occurs, involves at least partially some SDW formation (characterized by reduced free energy among metallic electrons due to the SDW). As discussed later, the Stanford electron tunneling study of LaSrCuO may show evidence of an incommensurate SDW in the by-now-famous dI/dV versus voltage curve which shows three peaks on the positive voltage side and similar structure on the negative voltage side, instead of the single peak on each side expected for a BCS superconductor. However at the present time it is not known whether a CDW or SDW state occurs or not in the high-T/sub c/ superconductors.

**10224 Effect of structural and antiferromagnetic phase transitions on superconductivity.** Gorbatsevich, A.A.; Elesin, V.P.; Kopaev, Yu.V. pp 429-433 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The problem of coexistence of three types of ordering, i.e., charge density wave (CDW), spin density wave (SDW), and superconductivity, can be studied systematically. It is shown that coexistence is absent in the case of a symmetric superconducting solution, and the coupling constant for triplet dielectric pairing (SDW) is smaller than for singlet pairing (CDW), and vice versa in the case of an antisymmetric superconducting solution.

**10225 Effects of Coulomb interaction on superconductivity.** Takada, Y. (Univ. of Tokyo (Japan)). pp 435-444 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

In this paper, a detailed investigation is made of the Coulomb effects by considering a possibility of superconductivity in the electron gas in which only the Coulomb interaction is included. By using the RPA for the electron-electron interaction, the present author discussed the same problem in 1978 in the weak-coupling KMK scheme. The author obtained the result that superconductivity appeared when the electronic density parameter r/sub s/ is larger than 6. Later, a similar result was obtained by Rietschel and Sham even when the strong-coupling Eliashberg equation was solved instead of the KMK scheme, as long as the RPA was used. It is clear, however, that the RPA is not a good approximation for r/sub s/ $> 1$. Grabowski and Sham tried to go beyond the RPA, but their calculation was far from a first-principle one. Probably the ordinary Green's function method which they employed will not provide reliable results for this problem, because there are no good expansion parameters in the theory for r/sub s/ $> 1$. The problem is approached in the method of effective-potential expansion which is known to provide a very accurate description of the normal state of the electron gas. The results for the correlation energy epsilon/sub c/ in the Green's function Monte Carlo (GFMC) method are reproduced by the method with relative errors less than 1% for $1 \leqq$ r/sub s/ $\leqq 10$.

**10226 Importance of different two-dimensional plasmon branches for high T/sub c/ superconductors.** Kresin, V.Z.; Morawitz, H. (Lawrence Berkeley Lab., CA (USA)). pp 445-449 of Novel superconductivity. Wolf, S.A.; Kresin, V.Z. (eds.). New York, NY; Plenum Press (1987). (CONF-870682—).

From International workshop on novel mechanisms of superconductivity; Berkeley, CA, USA (22 Jun 1987).

The plasmon mechanism of superconductivity in the new high T/sub c/ superconductors is characterized by the appearance of two physically distinct branches. They arise from the presence of several partially occupied carrier bands and the reduced dimensionality. Dispersion relations of these branches are derived in rand phase approximation (RPA) and the effect of deviation from RPA is discussed. The possible hybridization with polar phonon modes and the consequences on contributions to superconductivity and optical properties are presented. Additionally the implications for tunneling and neutron scattering experiments are sketched.

**10227 Zone-axis patterns in reflection high-energy electron diffraction: a family of new techniques for surface characterization.** Shannon, M.D.; Eades, J.A.; Meichle, M.E.; Turner, P.S. (Univ. of Illinois, Urbana (USA)). *Ultramicroscopy;* **16**: 175-192(1985). Contract AC02-76ER01198.

A family of techniques is presented for the transmission electron microscopy that generate surface zone-axis patterns. These patterns display the variation of the diffracted-beam intensity as a function of the angle of the incident electrons. The conditions of the experiments are those of reflection high-energy electron diffraction at near grazing incidence. The techniques are: surface convergent-beam diffraction, a surface analogue of the Tanaka method and a modified double-rocking scheme. Experimental results are presented for diffraction from surfaces of MgO and $MoS_2$. The authors anticipate that surface zone-axis patterns (surface ZAPs) will become established as an important tool for surface characterization, especially when used in conjunction with high-resolution surface imaging and surface energy loss spectroscopy; surface ZAPs may be expected to play, in surface analysis, a role analogous to that played by convergent-beam diffraction in normal transmission electron microscopy. 24 references, 16 figures.

## 6561 Superconductivity

*REFER ALSO TO CITATION(S) 8108, 8130, 8182, 8187, 8219, 8237, 8245, 8254, 8276, 8279, 8280, 8281, 8282, 8283, 8284*

**10228 (AD-A—198635/5/XAB) Critical nucleation field at the structured surface of a superconductor. Technical report.** Wu, Z.C.; Jelski, D.A.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Aug 1988. 24p. (UBUFFALO/DC—88/TR-80). NTIS, PC A03/MF A01.

The effect of the structured surface of a superconductor on the critical nucleation field is discussed in two cases: one with the magnetic field parallel to the grating wavenumber and the other parallel to the ripples. In the first case, it is found that the critical field is reduced as a function of grating height, whereas in the latter case it is increased.

**10229 (BNL—41976) Normal state resistance and low temperature magnetoresistance of superconducting cables for accelerator magnets.** Sampson, W.B.; Garber, M.; Ghosh, A.K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880812—30). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004528/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

The normal state resistivity of the superconducting NbTi cable used in accelerator magnets is usually specified by the resistance per unit length at room temperature (295 K) and the residual resistance ratio (RRR). Using these resistance parameters, the amount of copper in the multifilamentary wire can be calculated. This method is consistent with the traditional etch and weigh technique, and as such is a alternative and convenient way of specifying

the copper to superconductor ratio. In principle the magnetoresistance can be calculated from the RRR and the "Kohler Plot", for copper. In practice however, measurements of magnetoresistance for a wide variety of SSC inner cables show considerable disagreement with calculation. In this paper the magnetoresistance data on cables with RRR ranging from 50 to 175 are analyzed taking into account the conductor geometry and the effect of the small interfilamentary spacing on the resistivity of copper. 8 refs., 5 figs., 1 tab.

10230 **(BNL—41977) The effect of self field on the critical current determination of multifilamentary superconductors.** Garber, M.; Ghosh, A.K.; Sampson, W.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-880812—31). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004527/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

In determining the short sample critical current of conductors of large cross section or high current density the self field produced by the transport current must be taken account in order to obtain a "true value" for the critical current. A simple model calculation for determining this effect is described. Measurements on wires, cables, and monoliths show the validity and self consistency of the procedures. 9 refs., 13 figs., 1 tab.

10231 **(CONF-880529—7) High-fluence neutron irradiation of superconducting NbN films.** Weber, H.W.; Gregshammer, P.; Kampwirth, R.T.; Gray, K.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004209/JAW.

From MRS international meeting on advanced materials; Tokyo, Japan (30 May 1988).

A variety of sputtered NbN films have been irradiated with reactor neutrons at ambient temperature up to a total fluence of $10^{23}$ $m^{-2}$ (E > 0.1 MeV). Only small decreases of T/sub c/ (4--7%) and moderate increases of {rho}/sub n/ ({approximately}25%) are observed. Both of these quantities are difficult to interpret because of the granular nature of the films. The critical current densities have been determined in most cases for magnetic fields up to 20 T. While some degradation ({approximately}30%) of j/sub c/ occurs in the intermediate field range (6–15 T), the high field data show no change of j/sub c/ or even small increases due to the radiation-induced increase of H/sub c2/ and the occurrence of peak effects near H/sub c2/. The present experiments demonstrate unambiguously that NbN is an extremely radiation-hard high-field superconductor. 17 refs., 9 figs., 2 tabs.

10232 **(CONF-880705—10) Low field magnetic properties of superconducting $Tl_2Ba_2Ca_2Cu_3O_{10}$ single crystals.** Liu, J.Z.; Vandervoort, K.G.; Claus, H.; Crabtree, G.W.; Lam, D.J. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004357/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

Low field characterization of single crystals of $Tl_2Ba_2Ca_2Cu_3O_{10}$ using shielding, Meissner, and flux trapping measurements in fields of 0.2--40 Oe are presented. The highest inductive onset observed is 124 K. It is found that the shielding signal is highly nonlinear in the applied field down to the lowest temperatures. The Meissner effect is found to be about 15% of the shielding effect. 8 refs., 3 figs.

10233 **(CONF-8809199—1) Oxygen diffusion in high-T/sub c/ superconductors.** Rothman, S.J.; Routbort, J.L.; Nowicki, L.J.; Goretta, K.C.; Thompson, L.J.; Mundy, J.N.; Baker, J.E. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). Aug 1988. Contract W-31109-ENG-38;AC02-76ER01198. 17p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003640/JAW.

From DIMETA-88: international conference on diffusion in metals and alloys; Balatonfuered, Hungary (5 Sep 1988).

The present paper reviews oxygen diffusion data in high T/sub c/ superconductors. The model of defect interactions in La/sub 2-x/Sr/sub x/$CuO_4$, obtained from oxygen tracer diffusion measurements combined with positron annihilation results, is reviewed. Recent oxygen tracer diffusion measurements in polycrystalline $YBa_2Cu_3O$/sub 7-δ/ are presented. These results are discussed in the framework of the theory of Bakker et al. Chemical diffusion coefficients are reviewed and compared with the tracer values. 28 refs., 9 figs., 1 tab.

10234 **Heavy-fermion system: Superconducting and magnetic fluctuations within a periodic-cluster Hubbard model.** Reich, A.; Falicov, L.M. (Physics Department and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 Copenhagen OX, Denmark). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11199-11208(1 Dec 1988).

An exact solution of an eight-site crystal model with periodic boundary conditions, a small face-centered-cubic crystal, is presented for the case of a heavy-fermion system. The model consists of (a) single, fully symmetric orbital per site, with nearest-neighbor and second-nearest-neighbor hopping; (b) an infinite Coulomb repulsion between electrons on the same site; (c) antiferromagnetic superexchange interactions; and (d) band fillings near half filling (six, seven, and eight electrons per cluster). The superconducting and the antiferromagnetic correlations are studied and compared with the predictions of the noninteracting limit. The suitability of Bardeen-Cooper-Schrieffer and Gutzwiller approximate ground-state wave functions are quantitatively estimated.

10235 **Thermodynamic Bethe-ansatz equations for the Hubbard chain with an attractive interaction.** Lee, K.; Schlottmann, P. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11566-11571(1 Dec 1988).

The thermodynamic Bethe-ansatz equations for the one-dimensional Hubbard model are derived for an attractive on-site interaction of the electrons, extending in this way Takahashi's result for the repulsive Hubbard chain. The results are discussed in several special limits, e.g., interaction much larger than the hopping, U→0 case, and the high- and low-temperature limits. The dominating states at low temperatures consist of spin-paired electrons (resembling Cooper pairs) and bound states of such pairs. The excitation spectrum and its properties are discussed in the context of superconductivity and resonant valence bonds.

10236 **Pippard-coherence-length tensor for anisotropic superconductors.** Meuth, H. (Lawrence Berkeley Laboratory, University of California, One Cyclotron Road, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11923-11926(1 Dec 1988).

In the framework of a generalized fully anisotropic Bardeen-Cooper-Schrieffer-type quantum theory, the low-temperature, low-field coherence-length tensor is derived from first principles. Anisotropy of the Fermi surface, the gap parameter, and the energy band structure in the effective-mass approximation is included. For lattice parameters and effective-mass ratios suitable for the high-T/sub c/ superconductors the coherence lengths along the principal axes show a marked anisotropy exceeding 20:1. The coherence length along the c axis is found to be of the order of the lattice spacing c, suggesting marginal two dimensionality.

10237 **Construction of a well-defined free energy from the harmonic approximation for Josephson junctions.** Fishman, R.S. (Solid State Division, P.O. Box 2008, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11996-11999(1 Dec 1988).

The trial free energy of the harmonic approximation, which has been widely used to study Josephson junctions, diverges to negative infinity in the normal state for any finite temperature because a nonperiodic, harmonic Hamiltonian is used to describe a periodic system. In this paper, I employ a periodic, scalloped potential to construct a well-defined free energy, which is then minimized to obtain self-consistent solutions that are close to the harmonic solutions when phase fluctuations are small.

**10238 Metal-insulator transition in random superconducting networks.** Soukoulis, C.M.; Grest, G.S.; Li, Q. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **38**: No. 16, 12000-12003(1 Dec 1988).

The nature of the eigenstates and the effects on the superconducting-to-normal phase boundary in a two-dimensional random superconducting network are examined by finite-size scaling transfer-matrix calculations within the mean-field Ginzburg-Landau theory of second-order phase transitions. Results for a site-diluted square lattice are presented and a rich structure in the mobility-edge trajectory is obtained. The critical exponent for the slope of the critical field on (p-p/sub c/) is calculated and compared with previous estimates.

## 6570 Theoretical And Mathematical Physics

*REFER ALSO TO CITATION(S) 7914, 8508, 8677, 8736, 9803, 9889, 9891, 9924, 9935, 9935, 9936, 10403*

**10239 (AD-A—198637/1/XAB) Dynamics of observed reality: abridged version of classical and quantum mechanics. Technical report.** Haque, A.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Aug 1988. 21p. (UBUFFALO/DC—88/TR-81). NTIS, PC A03/MF A01.

This paper is concerned with a unified description of classical and quantum physics. A different way of thinking about the quantum world is expounded, which already has led to significant results in statistical mechanics and holds future promise for quantum mechanics. An explanation is provided for the original motivation in quantum theory, the formalisms that have evolved from it, and their differences with the classical theories. The conceptual difficulty that permeates our view of the microscopic world is spelled out and a remedy thereof suggested.

**10240 (AD-A—199349/2/XAB) Hybrid-iterative approach for rcs modeling on supercomputers. Final technical report, December 1983-October 1986.** Thiele, G.A.; Murthy, P.K.; Penno, R.P. (Dayton Univ., OH (USA). School of Engineering). May 1988. 70p. (UDR-TR—86-133). NTIS, PC A04/MF A01.

An iterative method is developed for computing the current induced by plane-wave excitation on conducting bodies of arbitrary shape. In this method, the scattering body is divided into lit- and shadow-side regions separated by the geometric optics boundary. An MFIE is written for each region. Each MFIE is solved by iteration (i.e., method of successive substitutions). In order to accomplish this, it is often necessary to have an initial estimate of the shadow-side current. This estimate is obtained from edge-diffraction theory or Fock theory. Hence, the method is called a hybrid-iterative method (HIM). The HIM is well-suited for use on a super computer like the Cray XMP. Results are shown for 2-dimensional objects whose size varies from 0.6 wavelengths to 440 wavelengths, all with CPU times under one minute.

**10241 (ANL-HEP-CP—88-49) A presentation for Virasoro algebras.** Zachos, C.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. (CONF-8806105—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003883/JAW.

From 17. international colloquium on group theoretical methods in physics; Quebec, Canada (27 Jun 1988).

The entire Virasoro, Ramond and Neveu-Schwarz algebras can each be constructed from a finite number of well-chosen generators satisfying a small number of conditions. Our most economical sets consist of just two starting generators in all cases, subject to no more than six conditions for the Virasoro case, five conditions for the Ramond case, and nine conditions for the Neveu-Schwarz case. Consequently, the Virasoro algebra simply amounts to 6 equations in two operator unknowns, and correspondingly 5 to 9 equations for the foregoing superalgebras. 2 refs.

**10242 (CBPF-NF—004/88) Antipodal universes in the topology S/sup 3/xR and H/sup 3/xR.** Sasse, F.D.; Soares, I.D.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 29p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88704999/JAW.

We introduce a two-parameter family of left-invariant metrics gL and right-invariant metrics gR on the Lie groups S/sup 3/XR and H/sup 3/XR with the aim of characterizing causality features in such universes. (M.W.O.).

**10243 (CBPF-NF—007/88) Potts ferromagnet: transformations and critical exponents in planar hierarchial lattices.** Hauser, P.R.; Curado, E.M.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705001/JAW.

We prove that the duality transformation for a Potts ferromagnet on two-rooted planar hierachical lattices (HL) preserves the thermal eigenvalue. This leads to a relation between the correlation lenght critical exponents $\nu$ of a HL and its corresponding dual lattice. Using hyperscaling we show that their specific heat critical exponents $\alpha$ coincide. For a smaller class of HL-namely of diamond and tress types-we prove that another transformation also preserves $\nu$ and $\alpha$.

**10244 (CBPF-NF—009/88) Phenomenological theory of ferromagnets without anisotropy.** Baltensperger, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Theoretische Physik). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705003/JAW.

The phenomenological equations of micromagnetics which contain the exchange energy and the magnetic energy are generalized to allow for a change in the magnitude of the magnetization. This permits the treatment of line singularities in the field free configurations with circular concentric magnetization lines. For an ellipsoid with a rotation axis the free energy of such an arrangement is compared that of the homogenously magnetized sample, which is the stable form for a sufficiently small sample (roughly with a radius <- 20 lattice constants). (M.W.O.).

**10245 (CBPF-NF—012/88) Einsteins's theory of gravity in Fierz variables.** Novello, M.; Pinto Neto, N. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 77p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705004/JAW.

We present a complete theory of massive and massless spin-two field using Fierz variables A $\alpha$ $\beta$ $\mu$; its relationship with the standard variable PSI $\mu\nu$ and the bridge relation which allows the passage from one representation to the other. We develop the Hamiltonian formalism for both the massive and the massless cases. The theory thus presented is nothing but Einstein's General Relativity in the Jordan - Lichnerowicz formulation. We then discuss an unification program in which a new short-range force is postulated. This force becomes the local counterpart of gravity in the same way we can think that weak interaction is the short-range counterpart of electrodynamics.

**10246 (CBPF-NF—013/88) Spin two field description in Fierz variables. I- The case of Minkowski space time.** Novello, M.; Pinto Neto, N. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705005/JAW.

We present the hamiltonian formulation of massive spin 2 field using Fierz variables.

**10247 (CBPF-NF—014/88) Does there exist a cosmological horizon problem.** Novello, M.; Jorda, S.D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705006/JAW.

We show that for photons non-minimally coupled to gravity the so called cosmological horizon problem does not exist.

10248 **(CBPF-NF—018/88) Relations between the density matrix and thermodynamic potential.** Pitanga, P.; Mundim, K.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705010/JAW.

We propose to study the stability of a polyatomic molecular system in terms of the thermodynamic potential G. This enables us to establish a relation between the bond index and susceptibility tensor ∂/sup 2/G/∂μ/sub i/∂ /sub j/.

10249 **(CBPF-NF—020/88) Symplectic projector in constrained systems.** Pitanga, P.; Amaral, C.M. do. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705011/JAW.

In this work we develop a geometric formalism for constrained hamiltonian systems. Using a sympletic projector, we can write the Dirac bracket of two functions as the Poisson bracket of the projected function on a submanifold defined by a local basis of 1-forms. This approach yields in a natural all properties associated to a generalized symplectic structure.

10250 **(CBPF-NF—022/88) Cr-Gd exchange coupling constants in Cr doped GdAlO/sub 3/.** Helman, J.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705013/JAW.

The splitting of the fluorescence spectrum of Cr as a function of an external magnetic field in the system GdAlO/sub 3/ with diluted Cr impurities at Al sites, was indicative of a puzzling dependence of the Cr-Gd exchange coupling constant J/sub 1/ on the magnetization. Here it is shown that this dependence is an artifact simulated by the existence of an appreciable exchange coupling J/sub 2/ between Cr and its next nearest neighbor Gd ions. J/sub 2/ has opposite sign to J/sub 1/ (≅ 2,05 cm/sup -1/) and it is roughly an order of magnitude smaller.

10251 **(CBPF-NF—031/88) Some results from a Mellin transform expansion for the heat Kernel.** Malbouisson, A.P.C.; Simao, F.R.A.; Camargo Filho, A.F. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705018/JAW.

The coefficients of a new Heat Kernel expansion, in the case of a differential operator containing a gauge field. The meromorphic structure of the generalized zeta-function obtained by that expansion is compared with the one obtained in a proceeding paper. The expansion is applied to anomalies, obtaining a general formula for arbitrary dimension D. The special cases D=2 and D=3 are investigated.

10252 **(DOE/ER/03075—T1) Supplies in gravitational dynamics and electroweak symmetry breaking.** Soldate, M. (Yale Univ., New Haven, CT (USA). Dept. of Physics). 16 Nov 1988. Contract AC02-76ER03075. 36p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005001/JAW.

During the past few years, my research interests have centered on physics associated with the Planck and electroweak scales. In each instance there is a physical issue which has motivated my work. The first is the dynamical determination of the observed geometry of spacetime. Typically, in a theory of quantum gravity, the topology and long-distance geometry of spacetime are not fixed uniquely by the field equations. One would like to be able to determine them through a dynamical principle for predictive power. The matter is of particular relevance to superstring theories, as they are most simply formulated in 10-dimensional Minkowski space. The second topic is the origin of electroweak symmetry breaking (EWSB). My work here has tended to be more phenomenological; it appears unlikely that a complete understanding of the gauge hierarchy problem can be obtained without some experimental knowledge of particles rather directly related to EWSB. I feel that both of these issues are of broad interest. In this paper, I will describe my future research plans in these areas after motivating and summarizing my previous work on them. 22 refs.

10253 **(DOE/ER/13493—2) Theory of condensable gases: Progress report, March 1, 1987--February 28, 1988.** White, J.A. (American Univ., Washington, DC). Feb 1988. Contract FG05-86ER13493. 5p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003055/JAW.

Over the past twelve months progress was made in the following three areas: Mathematical formulation of the theory; Numerical approximation methods; Equation of state for the hard sphere gas. These are discussed in this paper.

10254 **(DOE/ER/45189—2) [Theory of non-equilibrium growth]: Progress summary.** (Michigan Univ., Ann Arbor (USA)). 1988. Contract FG02-85ER45189. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003680/JAW.

This paper discusses non-equilibrium growth in diffusion limited aggregation. (LSP)

10255 **(GSI—88-39-Prepr.) Continuum states of the two-centre Dirac equation.** Rumrich, K.; Greiner, W.; Soff, G.; Wietschorke, K.H.; Schlueter, P. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Hoechst A.G., Frankfurt am Main (Germany, F.R.). Technische Leitsysteme; Siemens A.G., Muenchen (Germany, F.R.). Zentralbereich Forschung und Technik). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1988. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755946/JAW.

Continuum wave functions of the two-centre Dirac equation are evaluated for positive as well as negative energy states. In particular solutions for superheavy systems and large two-centre distances are investigated. The calculation of phase correlation diagrams provides a reliable tool for the search for resonance states in the negative energy continuum.

10256 **(IFT-P—08/88) Dirac Bracket quantization of chiral scalar two dimensional QED.** Abdalla, E.; Abdalla, M.C.B.; Devecchi, F.P.; Zadra, A. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705075/JAW.

The interaction of two dimensional chiral bosons with an eletromagnetic field, quantizing the system via Dirac procedure, is discussed. A quantum theory is obtained, however due to the mass generation the system is consistent only if further constraints are imposed. In such case, the electromagnetic field is trivial. The role of the gauge Jackiw-Rajaraman mass parameter is also discussed.

10257 **(IFT-P—11/88) Non polynomial interaction: stability and Borel summability.** Costa, G.A.F.T. da; Gomes, M. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil); Sao Paulo Univ., SP (Brazil). Inst. de Fisica). (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 30p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705076/JAW.

We prove Borel summability of the perturbative expansions for the energy levels of the one-dimensional quantum system with the rotational potential 1/2x/sup 2/ + g/sup 2/x/sup 6//(1+αgx/sup 2/).

10258 **(IFT-P—20/88) Remark on the gravitational field produced by an infinite straight string.** Francisco, G.; Matsas, G.E.A. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705077/JAW.

We compare the results predicted by Newtonian Gravity and General Relativity regarding the field produced by an infinite string with constant density λ. A simple gedanken experiment is suggested to stress the remarkable differences betwenn these two theories. The existence of the usual newtonian limit is discussed in this case.

**10259 (IFT-P—22/88) Vertex operators and Jordan fields.** Ferreira, L.A.; Gomes, J.F.; Zimerman, A.H. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705078/JAW.

The construction of Lie algebras in terms of Jordan algebras generators is discussed. The key to the construction is the triality relation already incorporated into matrix products. A generalisation to Kac-Moody algebras in terms of vertex operators is proposed and may provide a clue for the construction of new representations of Kac-Moody algebras in terms of Jordan fields.

**10260 (IFT-P—24/88) Morse oscillator generalised from supersymmetry.** Drigo Filho, E. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705079/JAW.

Using the fatorization method in supersymmetric quantum mechanics, new potentials from the Morse oscillator, are determined.

**10261 (IFUSP-P—611) Critical scattering by bubbles.** Fiedler-Ferrari, N.; Nussenzveig, H.M. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica; Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Fisica). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Nov 1986. 68p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705082/JAW.

We apply the complex angular momentum theory to the problem of the critical scattering of light by spherical cavities in the high frequency limit (permittivity greater than the external media) (e.g, air bubble in water) (M.W.O.).

**10262 (IFUSP-P—697) Semiclassical analysis of the SO(3,1) S-matrix.** Hussein, M.S.; Pato, M.P.; Iachello, F. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica; Yale Univ., New Haven, CT (USA)). (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705089/JAW.

A semiclassical analysis of the SO(3,1) S-matrix is performed. In particular: the near-far components of the amplitude and describe the nuclear rainbow scattering is discussed. The semiclassical inverse scattering theory to obtain the underlying potential, which is found to behave as r/sup -1/2/ e/sup -r/a/ at large separations, is used.

**10263 (IFUSP-P—702) Hadron interferometry for expanding sources.** Hama, Y. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Mar 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705093/JAW.

Hambury-Brown-Twiss effect is discussed for high-energy hadron-hadron or nucleus-nucleus collisions, where the particle emitting sources are typically in rapid expansion. On the light of the general results, we examine the recently obtained heavy-ion data and propose procedures for analyzing new data.

**10264 (IFUSP-P—709) On the non-equivalence of random-field ferromagnets and site-disordered antiferromagnets: fluctuations.** Matos, J.A. de; Baeta Segundo, J.A.; Perez, J.F. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). May 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705096/JAW.

It is shown that fluctuations of the order parameter in the Curie-Weiss versions of the dilute antiferromagnet and of the Ising model with random magnetic field are not equivalent under the mapping which establishes their thermodynamical equivalence.

**10265 (INIS-mf—11327) Matter wave interferometry in the light of Schroedinger's wave mechanics.** (Atominstitut der Oesterreichischen Universitaeten, Vienna; Erwin Schroedinger Society, Vienna (Austria)). 1987. 85p. (CONF-8709331—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW.

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

This is a pre-conference abstracts collection for 67 oral presentations and posters, 62 of them are in INIS scope and are treated individually. The subject matters are interferometers (mainly neutron), interferometry experiments and the related interpretation - and epistemological problems of quantum theory. (qui).

**10266 (INIS-mf—11327, pp 2) Fizeau effect for neutrons passing through matter at a nuclear resonance.** Arif, M.; Kaiser, H.; Clothier, R.; Berliner, R.; Werner, S.A.; Hamilton, W.A.; Klein, A.G. (Missouri Univ., Columbia (USA). Dept. of Physics; Melbourne Univ., Parkville (Australia). School of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10267 (INIS-mf—11327, pp 3) Derivation of quantum phenomena from a wave system model.** Andrews, T.B. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10268 (INIS-mf—11327, pp 4) Experimental options for testing a de Broglie standing wave theory.** Aspden, H. (Southampton Univ. (UK)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10269 (INIS-mf—11327, pp 5) Polarized neutron interferometry: a survey.** Badurek, G.; Rauch, H.; Summhammer, J. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10270 (INIS-mf—11327, pp 6) Two and three-dimensional tunnelling of neutral spin-1/2 particles through magnetic fields.** Barut, A.O.; Bozic, M. (Colorado Univ., Boulder (USA). Dept. of Physics; Institute of Physics, Beograd (Yugoslavia)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10271 (INIS-mf—11327, pp 7) Neutron optical imaging system for the determination of an upper limit of the neutron charge.** Baumann, J.; Kalus, J.; Gaehler, R.; Mampe, W. (Bayreuth Univ. (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik; Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10272 (INIS-mf—11327, pp 9) **Solution of two-dimensional stationary Schroedinger equation with cosine-like coefficient (in view of X-ray diffraction).** Bezirganyan, A.P.; Bezirganyan, P.A. (Yerevan State University, Department of Physics, Mravyan-1, 375049 Yerevan-49 (USSR)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10273 (INIS-mf—11327, pp 10) **Does the measurement reverse the direction of intrinsic time?.** Bialynicki-Birula, I. (Polish Academy of Sciences, Institute for Theoretical Physics, Lotnikow 32/46, 02-668 Warsaw (Poland)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10274 (INIS-mf—11327, pp 12) **Non-ergodic interpretation of quantum mechanics and neutron interferometry.** Buonomano, V. (Universidade Estadual de Campinas (Brazil). Inst. de Matematica). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10275 (INIS-mf—11327, pp 15) **New way to detect de Broglie's empty waves by neutron interferometry.** Croca, J.R.; Garuccio, A. (Faculdade de Ciencias Universidade de Lisboa, Departamento de Fisica, Lisboa (Portugal); Bari Univ. (Italy). Ist. di Fisica). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10276 (INIS-mf—11327, pp 17) **Short demonstration of the energy concept E-vector((mv)-vector)c as a desideratum of microphysics.** Dellian, E. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10277 (INIS-mf—11327, pp 20) **Schroedinger equation as the main quantization principle.** Entralgo, E.; Kuryshkin, V.V. (Dubna, JINR (USSR)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10278 (INIS-mf—11327, pp 21) **Test of the time dependent Schroedinger equation with very slow neutrons.** Felber, J.; Gaehler, R.; Golub, R. (Technische Univ. Muenchen (Germany, F.R.); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10279 (INIS-mf—11327, pp 26) **Electron optical SAGNAC experiment.** Hasselbach, F.; Nicklaus, M. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Angewandte Physik). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10280 (INIS-mf—11327, pp 27) **Neutron spin-Pendelloesung resonance.** Horne, M.A.; Finkelstein, K.D.; Shull, C.G.; Zeilinger, A.; Bernstein, H. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10281 (INIS-mf—11327, pp 28) **Basic concepts introduced by the new frames in physics.** Iida, Shuichi. (Tokyo Univ. (Japan)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10282 (INIS-mf—11327, pp 29) **Neutron interferometry investigation of the Aharonov-Casher effect.** Arif, M.; Kaiser, H.; Clothier, R.; Berliner, R.; Werner, S.A.; Cimmino, A.; Klein, A.G. (Missouri Univ., Columbia (USA). Dept. of Physics; Melbourne Univ., Parkville (Australia). School of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10283 (INIS-mf—11327, pp 30) **Schroedinger inviolate?.** Klein, A.G. (Melbourne Univ., Parkville (Australia). School of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10284 (INIS-mf—11327, pp 31) **Under the same geometrical conditions, whether the constant-λ two-beam Dirac self-interferences are same among various interfering particles?.** Koh, Yujiro; Sasaki, Toku. (Ibaraki Univ., Mito (Japan). Dept. of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10285 (INIS-mf—11327, pp 34) **Bell type inequalities a la Schroedinger.** Kraus, K. (Wuerzburg Univ. (Germany, F.R.). Physikalisches Inst.). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10286 (INIS-mf—11327, pp 35) **Neutron diffraction by perfect vibrating crystals.** Kulda, J.; Vrana, M.; Mikula, P. (Nuclear Physics Institute, Rez near Prague (Czechoslovakia)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10287 (INIS-mf—11327, pp 36) **Topological phase effect on quantum resonance phenomena.** Kuratsuji, Hiroshi. (Ritsumeikan Univ., Kyoto (Japan)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10288 (INIS-mf—11327, pp 37) **Quantum physics and language.** Levy-Leblond, J.M. (Physique Theorique, Nice (France)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10289 (INIS-mf—11327, pp 38) **Path integrals in multiply connected spaces and the Aharonov-Bohm interference.** Liang, J.Q. (Shanxi University, Department of Physics, Taiyuan (China)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10291 (INIS-mf—11327, pp 42) **Bragg scattering of atoms from a standing light wave.** Martin, P.J.; Oldaker, B.G.; Miklich, A.H.; Pritchard, D.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10292 (INIS-mf—11327, pp 43) **Electron interferometry and holography of electrostatic fields: fundamental and applicative aspects.** Matteucci, G.; Missiroli, G.F.; Pozzi, G. (Bologna Univ. (Italy). Ist. di Fisica; Lecce Univ. (Italy). Ist. di Fisica). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10293 (INIS-mf—11327, pp 44) **Neutron spin echo and interference.** Mezei, F. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10295 (INIS-mf—11327, pp 46) **Some remarks on the quantum mechanics of the electron. Shift of the phase of the electron wave by the magnetic flux included between two coherent partial waves.** Moellenstedt, G. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Angewandte Physik). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10296 (INIS-mf—11327, pp 49) **Neutron interference and quantum measurement problem.** Namiki, Mikio. (Waseda Univ., Tokyo (Japan). Dept. of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10297 (INIS-mf—11327, pp 50) **Coherence in crystal optics.** Petrascheck, D. (Johannes Kepler Univ., Linz (Austria)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10298 (INIS-mf—11327, pp 52) **Possible experimental verification of retroactivity.** Rietdijk, C.W. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10299 (INIS-mf—11327, pp 54) **Stochastic geometry and quantum potential.** Roy, S. (Indian Statistical Inst., Calcutta). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10300 (INIS-mf—11327, pp 56) **Quantum interference effects on fermion clustering in a fermion interferometer.** Silverman, M.P. (Trinity Coll., Hartford, CT (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10301 (INIS-mf—11327, pp 57) **Schroedinger's discovery of coherent states.** Steiner, F. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10302 (INIS-mf—11327, pp 59) **Stochastic and deterministic attenuation of one beam in the neutron interferometer.** Summhammer, J.; Rauch, H.; Tuppinger, D. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10303 (INIS-mf—11327, pp 60) **New results on the Aharonov-Bohm effect with electron interferometry.** Tonomura, Akira. (Hitachi Ltd., Kokubunji, Tokyo (Japan). Central Research Lab.). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10304 (INIS-mf—11327, pp 62) **Interference and distinguishability in quantum mechanics.** Uffink, J.; Hilgevoord, J. (Institute for Theoretical Physics, Amsterdam (Netherlands)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10305 (INIS-mf—11327, pp 63) **Information measures in quantum mechanics.** Walker, E.H. (U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10306 (INIS-mf—11327, pp 64) **Testing Schroedinger's paradox with a Michelson interferometer.** Walker, E.H.; May, E.C.; Piantanida, T.; Spottiswoode, S.J.P. (U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland (USA); SRI International, Menlo Park, CA (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10307 (INIS-mf—11327, pp 65) **Neutron interference induced by gravity: new results and interpretations.** Arif, M.; Kaiser, H.; Clothier, R.; Werner, S.A. (Missouri Univ., Columbia (USA). Dept. of Physics). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

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10308 (INIS-mf—11327, pp 66) **Neutron paths through a perfect-crystal interferometer.** Wesley, J.P. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10309 (INIS-mf—11327, pp 67) **Interferometry with correlated fermions.** Yurke, B. (Bell Labs., Murray Hill, NJ (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10310 (INIS-mf—11327, pp 68) **Dynamic generation of Schroedinger cats and their detection.** Yurke, B.; Stoler, D. (Bell Labs., Murray Hill, NJ (USA); Bell Labs., Whippany, NJ (USA)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10311 (INIS-mf—11327, pp 69) **Probability theory in quantum mechanics according to E. Schroedinger.** Zambrini, J.C. (Warwick Univ., Coventry (UK)). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10312 (INIS-mf—11327, pp 70) **Neutron interferometry and neutron optics at M.I.T.** Zeilinger, A. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

10313 **(INIS-mf—11341) Chaotic systems are dynamically random.** Svozil, K. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). [1988]. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705195/JAW.

The idea is put forward that the significant route to chaos is driven by recursive iterations of suitable evolution functions. The corresponding formal notion of randomness is not based on dynamic complexity rather than on static complexity. 24 refs.

10314 **(INIS-mf—11342) Test of local causality with very short light pulses.** Svozil, K. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). [1988]. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705196/JAW.

It is explicitly shown that the nonvanishing spacelike or timelike contributions to the Feynman propagator of quantum field theory do not reflect any violation of local causality, such as propagation faster than light. An experiment is proposed to test the causality of quantum field theory by measuring the broadening of a very short light pulse. For these pulses theory predicts a nondissipative behaviour, with the pulse broadening only stemming from preparation and measurement uncertainties. 8 refs., 2figs.

10315 (INIS-SU—67/A, pp 3-6) **On the perturbation theory for determination of quasibound states.** Bruev, A.S. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

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In Experimental and theoretical physics. Collection.

Perturbation theory, designed for calculating spectrum of quasi-bound states and being true at random values of coupling parameter of the problem was constructed on example of anharmonic oscillator with square nonlinearity. It is shown, that the perturbation theory is applicable for determination of analytical dependence of the level energy on coupling parameter. Means for accelerating convergence of approximations, which lies in application of Pade approximates or eigenenergy method, were considered. 12 refs.; 1 fig.; 1 tab.

10316 (INIS-SU—67/A, pp 10-11) **On potential surfaces for spectra of rotational operators.** Bruev, A.S. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.

In Experimental and theoretical physics. Collection.

New method for determining potential surfaces is described. Application of potential surface method is not limited by the case of solving the system of three-member recursion relations with slowly changing coefficients, which is convenient for many physical appiications. As a concrete example, potential surfaces for hamiltonian rigid asymmetric gyroscope at random values of quantum numbers were found. 17 refs.

10317 **(LA-UR—88-3790) Global bifurcations in maps of the plane and in Rayleigh-Benard convection.** Kevrekidis, I.G.; Ecke, R.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 25p. (CONF-8708296—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003443/JAW.

From American Society of Metals (ASM) conference; Boston, MA, USA (1 Aug 1987).

Global bifurcations involving interactions of stable and unstable manifolds of saddle-type periodic points often play a major role in determining the observable dynamic behavior and the transitions to chaos in dynamical systems. In this paper we present a detailed experimental study of the dynamics of low-aspect-ratio Rayleigh- Benard convection; the experimentally observed two-parameter bifurcation diagram is strongly reminiscent of the behavior of model low-dimensional dynamical systems (maps of the plane, periodically forced systems of ODEs). Simple simulation is incapable of systematically detecting and analyzing these phenomena. We discuss an alternative computational approach to such global bifurcation problems. 41 refs., 8 figs.

10318 **(SAND—88-0980C) Modeling of diffusion processes: Numerical solutions to the diffusion equation.** Romig, A.D. Jr; Pehlivanturk, N.Y.; Inal, O.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 33p. (CONF-880901—13). NTIS, PC A03/MF A01 - OSTI. Order Number DE89003401/JAW.

From Metallurgical Society fall meeting and American Society for Metals materials week; Chicago, IL, USA (24 Sep 1988).

Many phenomena in materials science are controlled by volume diffusion. To model these phenomena it is often necessary to solve the diffusion equation under initial and boundary conditions for which analytical solutions do not exist. Specific examples requiring numerical solutions include cases where the initial composition profile is neither constant nor a simple error function, where the boundary compositions are constant nor a simple error function, where the boundary compositions are not fixed and vary as impingement occurs, and where diffusion occurs under non-isothermal conditions. Several numerical algorithms have been used to solve these problems including explicit finite differences, implicit finite differences (Crank-Nicholson), method of lines, and finite elements. The advantages and disadvantages of each technique will be described. In a tutorial fashion, a simple fixed boundary diffusion problem and a two-phase moving boundary problem will be solved analytically and numerically and the results compared. A more complex example of a diffusion problem requiring a numerical solution will also be given. 34 refs., 11 figs., 1 tab.

10319 **(SLAC-PUB—4690) Observable gravitational and electromagnetic orbits and trajectories in discrete physics.** Noyes, H.P.; McGoveran, D.O. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 28 Nov 1988. Contract AC03-76SF00515. 20p. (CONF-8809214—1). NTIS, PC A02/MF A01 - OSTI. Order Number DE89005012/JAW.

From Physical interpretations of relativity theory; London, UK (16 Sep 1988).

Our discrete and finite version of relativistic quantum mechanics provides an elementary particle physics consistent with the standard model of quarks and leptons. Our recent relativistic calculation of the bound state spectrum of hydrogen has allowed us to make a combinatorial correction to the first order estimate of $1/\alpha = \{Dirac\leftarrow h\}c/e^2 = 137$ derived from the combinatorial hierarchy and achieve agreement with experiment up to terms of order $\alpha^3$. The same theory requires that to first order $\{Dirac\leftarrow h\}c/Gm/sub\ p/^2 = 2^{127} + 136 \cong 1.7\ \{times\}\ 10^{38}$. Using the emission and absorption of spin 1 photons and spin 2 gravitons in this framework, we try to show that we can meet the three additional tests of general relativity—solar red shift, solar bending of light, and precession of the perihelion of Mercury. We predict that a macroscopic electromagnetic orbit would have four times the Sommerfeld precession for basically the same reason that Mercury has six times the Sommerfeld precession. 20 refs.

10320 **(UCID—21501) A geometric optics approximation to a model of phase-compensated whole-beam thermal blooming: 1, General theory and numerical verification.** Gautesen, A.K.; Morris, J.R. (Lawrence Livermore National Lab., CA (USA)). [1988]. Contract W-7405-ENG-48. 18p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004606/JAW.

We develop a geometric optics series expansion approximation to a model of phase-compensated whole-beam thermal blooming of high-power laser beams. The model consists of a nonlinear medium whose thermal blooming coupling coefficient decreases exponentially with the propagation distance from the laser and whose motion relative to the laser beam is taken to be unidirectional, a Gaussian high-power intensity profile at the laser, and a collimated beam boundary condition at an exit plane that is many e-folding scale lengths from the laser. The series expansion parameter is directly proportional to Smith's geometric optics distortion parameter. Expansion formulae are derived for both the intensity and phase at all propagation distances. The exit plane intensity profiles obtained from these formulae qualitatively agree with numerical results obtained from the wave-optics thermal blooming code FOURD, except when the FOURD results indicate that caustics are forming; quantitative agreement is also excellent, except for small differences in fine structure near the downwind edge of the beam. FOURD's return-wave phase-compensation iteration provides an estimate that the rms error in the initial phase obtained from our series approximation truncated at third-order is approximately 0.5% over the range of values we investigated. 3 refs., 2 figs., 1 tab.

10321 **(UWThPh—1988-14) Asymptotic properties of nodes of solutions to Schroedinger equations.** Hoffmann-Ostenhof, M.; Hoffmann-Ostenhof, T. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705224/JAW.

A survey is given of several results obtained previously on the asymptotic properties in relation with its nodes. A new result on the behaviour of local solutions in the neighbourhood of its zero is announced. Let the domain Ω be element R/sup n/ ($n \geqq 2$), x/sub 0/ element Ω, V element C/sup ∞/(Ω); psi notident 0; and psi element C/sup ∞/(Ω) satisfy $(-\Delta+V)psi=0$; psi(x/sub 0/)=0. The question arises if there exists a nodal domain D/sub r(sub 0)/ of psi for which the corresponding S(r) (S/sup n-1/ being the unit sphere in R/sup n/) shrinks, with $r->0$ into a subset of the nodal set of the Y/sub n/, the spherical harmonics. Defining psi/sub 0/=(∫/sub S(2)/psi/sup 2/ds)/sup 1/2/, the answer is: psi/sub 0/center dotr/sup -M/ and chemical bondS(2)chemical bond have finite non-zero limiting values for $r->0$. 14 refs. (qui).

10322 **(UWThPh—1988-18) Mixing properties of quantum systems.** Narnhofer, H.; Thirring, W. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705225/JAW.

We generalize the classical notion of topological mixing for automorphisms of C/sup */-algebras in two ways. We show that for Galilean invariant Fermi systems the weaker form of mixing is satisfied. With some additional requirement on the range of the interaction we can also demonstrate the stronger mixing property.

10323 **(UWThPh—1988-23) Machian effects in general relativity.** Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705227/JAW.

As a consequence of Mach's principle, rotating matter should cause local inertial frames or gyroscopes in its vicinity to undergo a small rotation which is not present in the Newtonian picture. H. Thirring and J. Lense were the first to derive similar predictions from the field equations of general relativity. Since these early days of relativity, a lot of exact and approximate solutions to Einstein's equations have been examined under this point of view. The qualitative features of Machian effects are most easily demonstrated in the cylinder symmetric case, where some exact results are available. For example, space-time is flat inside a uniformly rotating

matter shell, and the rotation of this interior with respect to 'infinity' (the distant stars) has a clear meaning. In the more realistic case of what happens near a massive rotating star, one is forced to perform certain approximations. In modern language, Machian effects are described in terms of the twist of timelike killing vector fields. In the linearized theory, the equations that determine the Machian structure generated by a given matter distribution, resemble to some extent those of classical electrodynamics. This correspondence provides a pedagogical approach how to compute the quantitative extent of inertial frame 'dragging'. 6 refs., 5 figs.

10324 **(UWThPh—1988-24) Will Schroedinger's cat be proved experimentally in near future?.** Flamm, D. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 7p. (In German). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705228/JAW.

The difference between a pure state, a statistically mixed state and the importance of interference in pure states are emphasized. Examples of quantum states are given where location, momentum or energy of a particle are not determined. As a model of a microscopic system a SQID is considered. Legget and Garg have derived inequalities analogous to the Bell's to decide experimentally if in a SQID at absolute zero temperature the magnetic flux is in a pure, i.e. indetermined state, or a statistically mixed state. Even if quantum mechanics is valid in macroscopic systems 'realism' need not to be abolished. (qui).

10325 **(UWThPh—1988-27) Dynamical entropy in quantum theory.** Narnhofer, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705231/JAW.

The theory of dynamical systems was initiated by the attempt of physicists to understand the approach to equilibrium. In the mean time it has become a highly developed field, but its application to physical problems is somewhat limited, because it is based on measure theory and therefore restricted to classical systems, whereas we know that nature, at least on a microscopic level, has to be described by quantum laws. Therefore it will be our aim to translate concepts of measure theory that have turned out to be qseful, into the quantum language. One of these concepts is the so-called dynamical entropy of flows that on one hand gives a qualitative characterization of those automorphisms with the best mixing behaviour, and in addition is also a quantitative measure how fast the system is mixed. We have been able to define a corresponding quantity also for quantum systems with a number of promising properties. To gain as much information about the system from this dynamical entropy as it was possible in the classical situation will be a challenge for the future. 19 refs.

10326 **(UWThPh—1988-31) On the calculation of the Berry phase in a solvable model.** Bulla, W.; Falkensteiner, P.; Grosse, H. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik; Vienna Univ. (Austria). Inst. fuer Theoretische Physik). (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705233/JAW.

We study fermions defined on a one-dimensional interval, for which the interaction is given by a four-parameter family of boundary conditions. We compare the full solution to the adiabatic approximation and determine the Berry phase for a number of typical orbits in parameter space. We observe the occurence of a non-trivial fundamental group and discuss the possibilities of avoided crossings and apparent crossings. 10 refs.

10327 **(UWThPh—1988-32) Symmetry of the Hubbard model.** Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 5p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705234/JAW.

The spectrum of the Hubbard model shows permanent degeneracy of levels with different symmetry, if one considers only symmetry operators independent of the coupling constant. This suggests the existence of symmetry operators which depend on the coupling constant. We find these highly nontrivial operators and show that they explain the degeneracies in the energy spectrum. 5 refs.

10328 **(UWThPh—1988-33) On the superunitary implementation of supersymmetry.** Grosse, H.; Pittner, L. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik; Graz Univ. (Austria). Inst. fuer Theoretische Physik). (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705235/JAW.

Observables and states of supersymmetric quantum mechanics are coded by taking the graded tensor product with anticommuting parameters. A supersymmetry is defined to conserve the supertrace of products of two coded projectors. We prove that every supersymmetry is implemented by an essentially unique superunitary transformation. 13 refs.

10329 **(UWThPh—1988-35) Bell's theorem and the nature of reality.** Bertlmann, R.A. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1988. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705237/JAW.

We rediscuss the Einstein-Podolsky-Rosen paradox in Bohm's spin version and oppose to it Bohr's controversial point of view. Then we explain Bell's theorem, Bell inequalities and its consequences. We describe the experiment of Aspect, Dalibard and Roger in detail. Finally we draw attention to the nonlocal structure of the underlying theory. 61 refs., 8 tabs.

10330 **Localized energy pulse trains launched from an open, semi-infinite, circular waveguide.** Shaarawi, A.M.; Besieris, I.M.; Ziolkowski, R.W. (Department of Electrical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Journal of Applied Physics;* **65**: No. 2, 805-813(15 Jan 1989).

A new decomposition of exact solutions to the scalar wave equation into bidirectional, backward and forward traveling plane waves is described. These elementary blocks constitute a natural basis for synthesizing Brittinghamlike solutions. Examples of such solutions, besides Brittingham's original modes, are Ziolkowski's electromagnetic directed energy pulse trains (EDEPTs) and Hillion's spinor modes. A common feature of these solutions is the incorporation of certain parameters that can be tuned in order to achieve slow energy decay patterns. The aforementioned decomposition is used first to solve an initial boundary-value problem involving an infinite waveguide. This is followed by considering a semi-infinite waveguide excited by a localized initial pulse whose shape is related directly to parameters similar to those arising in Ziolkowski's EDEPT solutions. The far fields outside the semi-infinite waveguide are computed using Kirchhoff's integral formula with a time-retarded Green's function. The resulting approximate solutions are causal, have finite energy, and exhibit a slow energy decay behavior.

10331 **Exponential power series expansion for the quantum time evolution operator.** Makri, N.; Miller, W.H. (Department of Chemistry, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **90**: No. 2, 904-911(15 Jan 1989).

The coordinate matrix element of the time evolution operator, exp[-iH-italic-circumflext/(h/2$\pi$)], is determined by expanding (its exponent) in a power series in t. Recursion relations are obtained for the expansion coefficients which can be analytically evaluated for any number of degrees of freedom. Numerical application to the tunneling matrix element in a double well potential and to the reactive flux correlation function for a barrier potential show this approach to be a dramatic improvement over the standard short time approximation for the propagator. Its use in a Feynman path integral means that fewer "time slices" in the matrix product exp[(-i/(h/2$\pi$))$\Delta$tH-italic-circumflex]/sup N/, $\Delta t = t/N$, will be required. The first few terms in the present expansion constitute a fully quantum version of the short time propagator recently obtained by us using semiclassical methods [Chem. Phys. Lett. 151, 1 (1988)].

**10332 Time-dependent inverse scattering from gradient-type interfaces using an exact solution.** Kreider, K.L. (Applied Mathematical Sciences, Ames Laboratory: U.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Journal of Mathematical Physics (New York);* **30**: No. 1, 53-58(Jan 1989).

In the context of one-dimensional linear wave propagation, a gradient-type interface is a point at which the velocity profile of a scattering medium suffers a jump in first derivative. In this paper, a time domain approach to scattering from such an interface leads to an integrodifferential equation involving the kernel of the reflection operator (impulse response), which can be solved exactly if the velocity profile is piecewise parabolic. This special case provides the basis for an approximate numerical scheme to solve the inverse scattering problem (recover the velocity profile from reflection data) for a general velocity profile. The algorithm is fast and affords good results if the velocity profile is nearly parabolic or the interest is in short time only. A detailed error estimate for the approximation is provided.

**10333 Dynamic impedance matching with a lever.** Crawford, F.S. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* **57**: No. 1, 52-56(Jan 1989).

Multiple elastic collisions are analyzed that occur between an incident mass $M_1$, a target mass $M_2$, and a single intermediating hinged lever of moment of inertia I that bounces back and forth between the two masses, transferring angular momentum and energy with each double collision until, if I is chosen correctly, 100% of the energy has been transferred from $M_1$ to $M_2$ in N double collisions, where N = 1, or 2, or 3, or ... . The model was inspired by the mechanical transformer, designed and built by Ansbacher, that employs two nearly massless levers as intermediaries so as to achieve nearly complete energy transfer between two masses on an air track.

**10334 Terrell effect.** Terrell, J. (Mail Stop D436, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *American Journal of Physics;* **57**: No. 1, 9-10(Jan 1989).

The author clarifys his work on the appearance of objects in special relativity. (AIP)

**10335 Axionic black holes and an Aharonov-Bohm effect for strings.** Bowick, M.J.; Giddings, S.B.; Harvey, J.A.; Horowitz, G.T.; Strominger, A. (Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Physical Review Letters;* **61**: No. 25, 2823-2826(19 Dec 1988).

It is shown that a black hole of fixed mass can carry arbitrary axionic charge. The unique static black-hole solution is found to have vanishing axion field strength but nonvanishing potential. The axion charge cannot be detected by point particles, but can be detected by strings in a process analogous to the Aharonov-Bohm effect. It is argued that the existence of axion charge may play a significant role in the late stages of black-hole evaporation.

**10336 Graviton emission by a thermal bath of photons.** del Campo, S.; Ford, L.H. (Department of Physics and Astronomy, Tufts University, Medford, Massachusetts 02155). *Physical Review [Section] D: Particles and Fields;* **38**: No. 12, 3657-3661(15 Dec 1988).

The rate of emission of gravitons by a thermal bath of protons is calculated. Linearized quantum gravity is used to find the rate of graviton creation by thermal fluctuations of the photons. For the case of photons confined within a sphere of radius R and volume V at temperature T, the power radiated in gravitons is found to be P = (2.7 x 10/sup -66/ erg/s)(V/cm$^3$)(T/K)$^7$ln(160RT/K/cm). If the thermal bath cools solely by emission of gravitons, the cooling time is of the order of tau = (3 x 10/sup 51/ s) (1 K/T)$^3$ln(160RT/K cm). Any region which has been cooling by graviton emission since the early Universe has a maximum temperature of 10 MeV at the present.

**10337 Observable effects of the quantum adiabatic phase for noncyclic evolution.** Wu, Y.; Li, H. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). *Physical Review [Section] B: Condensed Matter;* **38**: No. 16, 11907-11910(1 Dec 1988).

It is pointed out that, contrary to naive expectation, the gauge structure or Berry connection recently found in slowly varying quantum systems gives rise to observable effects even for noncyclic evolutions corresponding to open paths in parameter space. We propose to test such effects in muon spin resonance and in level-crossing resonance in muon-spin-rotation spectroscopy. In our proposals either the probe or the system itself has a lifetime much shorter than the period of one adiabatic cycle.

**10338 Complexity as thermodynamic depth.** Lloyd, S.; Pagels, H. (Department of Physics, Rockefeller University, New York, New York 10021). *Annals of Physics (New York);* **188**: No. 1, 186-213(15 Nov 1988).

A measure of complexity for the macroscopic states of physical systems is defined. Called depth, the measure is universal: it applies to all physical systems. The form of the measure is uniquely fixed by the requirement that it be a continuous, additive function of the processes that can result in a state. Applied to a Hamiltonian system, the measure is equal to the difference between the system's coarse- and fine-grained entropy, a quantity that we call thermodynamic depth. The measure satisfies the intuitive requirements that wholly ordered and wholly random systems are not thermodynamically deep and that a complex object together with a copy is not much deeper than the object alone. Applied to systems capable of computation, the measure yields a conventional computational measure of complexity as a special case. The relation of depth and thermodynamic depth to previously proposed definitions of complexity is discussed and applications to physical, chemical, and mathematical problems are proposed. copyright 1988 Academic Press, Inc.

**10339 Recent advances in methods for numerical solution of O.D.E. initial-value problems.** Bui, T.D.; Oppenheim, A.K.; Pratt, D.T. (Concordia Univ., Montreal, Quebec (Canada)). *Journal of Computational and Applied Mathematics;* **11**: 283-296(1984). Contract AC03-76SF00098.

This review paper describes recent advances in numerical methods and computer codes for solving initial-value problems of ordinary differential equations. Particular emphasis is placed upon stiff systems. 50 references.

## 70 FUSION ENERGY

**10340 (INIS-SU—60/A) Thermonuclear synthesis. Scientific-technical collection.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 88p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; No. 1.

Separate abstracts were prepared for the papers in this collection.

**10341 (IPPCZ—277/II) 14th Czechoslovak seminar on plasma physics and technology. Part II.** (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. 188p. (In English, Russian). (CONF-8703303—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW.

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

All 26 contributions included in the second part of the proceedings of the 14th Czechoslovak Seminar on Plasma Physics and Technology deal with various high-temperature plasma topics. The majority of papers (6) relate to plasma production, diagnostics, and to the lower hybrid current drive in the Czech tokamak Castor. Two papers refer to the diagnostics of a laser-produced plasma. Three contributions report the gas-puff-pinch experiment at the In-

stitute of Plasma Physics, Prague, fast ion measurements in Polish plasma focus devices, and the imploding liner experiment using the Soviet Angara-Modul accelerator, respectively. One paper summarizes the experimental results obtained with the Polish high-current electron accelerators Niva and Nike. Four contributions report the beam-plasma experiments performed on the Czech accelerator Rebex. Particular attention is paid to ultrasoft X-ray diagnostics. One invited paper (by prof. Kolomensky) surveys non-traditional methods of particle acceleration, two others discuss the active and passive methods of corpuscular plasma diagnostics. The rest of the papers concern miscellaneous theoretical problems of high-temperature plasma physics (e.g. Langmuir turbulence, kinetic plasma wave modes, superbanana diffusion in stellarators etc.). 83 figs., 1 tab., 160 refs.

## 7001 Plasma Research

*REFER ALSO TO CITATION(S) 8652, 8805, 9797, 9798, 9799, 10427, 10473, 10474, 10482, 10489, 10520*

10342 **(AD-A—198786/6/XAB) Development of quasi-optical gyrotrons for fusion-plasma heating. Memorandum report.** Manheimer, W.M.; Fliflet, A.W.; Burke, J.; Hargreaves, T. (Naval Research Lab., Washington, DC (USA)). 11 Jul 1988. 186p. (NRL-MR—6165). NTIS, PC A09/MF A01.

This memo documents the proposed research program on quasi-optical gyrotrons. The goal would be the design of a 1-2 MW CW source at 280 GHz to be built by industry for the purpose of heating such fusion reactors as CIT and ETR. These sources would be tunable to 30% by magnetic field and to a few percent by voltage. A prototype at slightly lower frequency would be constructed and this device would be experimentally characterized. The initial program would last for four years and would investigate physics issues at both the cyclotron frequency and its harmonic. A follow-on program lasting one to two years would design a 1-MW CW tube at 560 GHz and experimentally characterize such a megawatt tube at slightly lower frequency. These sources could be utilized for heating such tokamaks as CIT and ETR. At an intermediate stage, a source would be developed for heating Alcator C Mod at a frequency of 240 GHz. The overall program goal is to advance the state of the art of QOG's from the proof-of-principle level to an industrially relevant rf-source technology.

10343 **(AD-A—198823/7/XAB) Simulation of electrostatic modes in a magnetoplasma with transverse inhomogeneous electric field. Memorandum report.** Nishikawa, K.; Ganguli, G.; Lee, Y.C.; Palmadesso, P.J. (Naval Research Lab., Washington, DC (USA)). 31 May 1988. 38p. (NRL-MR—6206). NTIS, PC A03/MF A01.

Ion-cyclotron turbulence has been observed with shocks and double layers in the magnetosphere where strongly localized electric fields perpendicular to the magnetic field are present. Theoretical analysis suggests that electrostatic waves with frequency of the order of the ion cyclotron frequency can be destabilized due to the coupling of regions of positive- and negative-energy ion waves. The nonlocal theory for a smooth profile of transverse inhomogeneous electric fields shows that localized ion waves grow in the region where the electric fields are present. Using a spatially two-dimensional electrostatic code, the authors investigate this instability in plasma conditions characterized by a localized transverse electric field of width L < <L sub x, where L sub x is the simulation length in the x-direction; and distinguish it from the transverse kinetic Kelvin-Helmholtz instability. The simulation results show that the growing ion waves are associated with small vortices at the linear stage, which evolve into a nonlinear stage dominated by larger vortices with lower frequencies.

10344 **(AD-A—199564/6/XAB) Experimental studies of coaxial plasma-gun current. Final report, November 1985-December 1987.** Price, D.W. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Sep 1988. 404p. (AFWL-TR—88-79). NTIS, PC A18/MF A01.

This investigation examines a coaxial plasma gun, its plasma sheath currents, and related behavior. Plasma-gun applications are determined by the plasma behavior. The PUFF capacitor bank (72 micro F, 29 nH, 120 kV) drives the plasma gun using a deuterium fill gas. The gas breakdown site is isolated from the dielectric/vacuum interface in the AFWL system. Two-gas valves deliver gas in the system. The first delivers gas from the gun breech and the second optional valve delivers gas to the gun muzzle. Currents and voltages are measured by Rogowski coils, B-dot probes, and capacitive voltage probes. Silver-activation neutron detectors monitor fusion-product neutrons. In the snowplow mode, the plasma sheath is thin with a sharp current rise and drop. In the deflagration mode, the plasma sheath is diffuse over a large volume. Our system operated in a transition mode between the snowplow and deflagration modes with early snowplow behavior and late deflagration behavior. Neutrons are produced in a plasma pinch at the gun muzzle, indicating snowplow behavior. The slug theory models overall gun behavior to experimental accuracy. Sheath-thickness estimates show sheaths of at least 25% the gun length. Experimental results are compared to four theories for plasma-sheath velocities: the Alfven collisionally limited model, the Rosenbluth model, the Fishbine saturated model and a single particle drift model.

10345 **(CONF-8810231—3) WHIST transport analysis of high neutron production, ICRH heated, pellet fueled jet plasmas.** Houlberg, W.A.; Milora, S.L.; Tolliver, J.S.; Phillips, C.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003932/JAW.

From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising, F.R. Germany (24 Oct 1988).

The WHIST 1-1/2-D predictive transport code is used to model the particle and energy transport of JET pellet-fueled, ICRH-heated plasmas. Pellet injection during the current rise phase was used to produce strong central peaking of the particle density followed by central ICRH heating and led to transient period of enhanced confinement. The evolution of the density profile as well as the electron and ion temperature profiles and strong ICRH heating conditions are examined during this period of enhanced confinement in the context of models for particle and energy transport. Because WHIST is a predictive transport code, it requires models for particle and energy sources and transport coefficients. The analysis procedure thus consists of modeling the particle source terms (pellets, gas, and recycled neutrals), energy source terms (ohmic and ICRH heating), and energy loss terms (primarily radiation), and varying the transport models until the best qualitative and quantitative agreement is obtained between calculated and observed quantities. We find that plasma behavior is well described during the first second of ICRH heating following pellet injection by the same transport coefficients that describe the ohmic plasma. The distinction between electron and ion thermal losses depends on the relative heating rates of electrons and ions as determined by the ICRH model, as well as the radiation losses. 10 refs., 4 figs.

10346 **(DOE/ER/53203—4) Studies of electron temperature profiles on TEXT: Annual progress report.** Gandy, R.F. (Auburn Univ., AL (USA). Dept. of Physics). Dec 1988. Contract FG05-85ER53203. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005147/JAW.

The purpose of this project is to operate a 10-channel polychromator (GPC) for measurement of TEXT electron temperature profiles. This temperature profile information will be used in the study of thermal transport during ECH, pellet injection, and other types of discharges. Also to measure non-thermal emission during ECH in order to determine the suprathermal component (energy and density) of the electron distribution function. 2 figs.

10347 **(DOE/ER/53216—2) Wisconsin torsatron/stellarator program, FY 1989.** Shohet, J.L.; Anderson, D.T.; Anderson, F.S.B.; Talmadge, J.N. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). Jul 1988. Contract FG02-86ER53216. 253p. NTIS, PC A12/MF A01 - OSTI. Order Number DE89004241/JAW.

This proposal documents recent activities within the University of Wisconsin-Madison Torsatron/Stellarator Laboratory and presents plans for future research activities for a three year period. Research efforts have focused on fundamental stellarator physics issues through experimental investigations on the Interchangeable Module Stellarator (IMS) and the Proto-Cleo Stellarator. Theoreti-

cal activities and studies of new configurations are being undertaken to support and broaden the experimental program. Experimental research at the Torsatron Stellarator Laboratory has been primarily concerned with effects induced through electron-cyclotron resonant frequency plasma production and heating in the IMS device. Plasma electric fields have been shown to play a major role in particle transport and confinement in IMS. ECRF heating at 6 kG has produced electron tail populations in agreement with Monte-Carlo models. Electric and magnetic fields have been shown to alter the particle flows to the IMS modular divertors. 48 refs.

**10348 (DOE/ET/51013—256) Fast wave ion cyclotron resonance heating experiments on the Alcator C tokamak.** Shepard, T.D. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1988. Contract AC02-78ET51013. 208p. (PFC/RR—88-13). NTIS, PC A10/MF A01 - OSTI. Order Number DE89005035/JAW.

Minority regime fast wave ICRF heating experiments have been conducted on the Alcator C tokamak at rf power levels sufficient to produce significant changes in plasma properties, and in particular to investigate the scaling to high density of the rf heating efficiency. Up to 450 kW of rf power at frequency f = 180 MHz, was injected into plasmas composed of deuterium majority and hydrogen minority ion species at magnetic field $B_0$ = 12 T, density 0.8 ≦ {bar n{sub e}} ≦ 5 {times} $10^{20}$ $m^{-3}$, ion temperature T/sub D/(0) {approximately} 1 keV, electron temperature T/sub e/(0) {approximately} 1.5--2.5 keV, and minority concentration 0.25 {approx←lt} {eta{sub H}} ≦ 8%. Deuterium heating ΔT/sub D/(0) = 400 eV was observed at {bar n{sub e}} = 1 {times} $10^{20}$ $m^{-3}$, with smaller temperature increases at higher density. However, there was no significant change in electron temperature and the minority temperatures were insufficient to account for the launched rf power. Minority concentration scans indicated most efficient deuterium heating at the lowest possible concentration, in apparent contradiction with theory. Incremental heating {tau{sub inc}} {equivalent←to} ΔW/ΔP up to 5 ms was independent of density, in spite of theoretical predictions of favorable density scaling of rf absorption and in stark contrast to Ohmic confinement times {tau{sub E}} {equivalent←to} W/P. After accounting for mode conversion and minority losses due to toroidal field ripple, unconfined orbits, asymmetric drag, neoclassical and sawtooth transport, and charge-exchange, it was found that the losses as well as the net power deposition on deuterium do scale very favorably with density. Nevertheless, when the net rf and Ohmic powers deposited on deuterium are compared, they are found to be equally efficient at heating the deuterium. 139 refs.

**10349 (DOE/ET/51013—257) Ion Bernstein wave experiments on the Alcator C tokamak.** Moody, J.D. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1988. Contract AC02-78ET51013. 220p. (PFC/RR—88-14). NTIS, PC A10/MF A01 - OSTI. Order Number DE89005034/JAW.

Ion Bernstein wave experiments are carried out on the Alcator C tokamak to study wave excitation, propagation, absorption, and plasma heating due to wave power absorption. It is shown that ion Bernstein wave power is coupled into the plasma and follows the expected dispersion relation. The antenna loading is maximized when the hydrogen second harmonic layer is positioned just behind the antenna. Plasma heating results at three values of the toroidal magnetic field are presented. Central ion temperature increases of ΔT/sub i//Ti {approx←lt} 0.1 and density increases Δn/n < 1 are observed during rf power injection of up to 180kW at a frequency of 183.6 {times} $10^6$s/sup {minus}1/ for plasmas within the density range 0.6 {times} $10^{20}$m/sup {minus}3/ ≦ {bar n}/sub e/ ≦ 4 {times} $10^{20}$m/sup {minus}3/ and magnetic fields 2.4 ≧ ω/Ω/sub H/ ≧ 1.1. The density increases is usually accompanied by an improvement in the global particle confinement time relative to the Ohmic value. The ion heating rate is measured to be ΔT/sub i//P/sub rf/ ≃ 2-4.5 eV/kW at low densities. At higher densities {bar n}/sub e/ ≦ 1.5 {times} $10^{20}$m/sup {minus}3/ the ion heating rate dramatically decreases. It is shown that the decrease in the ion heating rate can be explained by the combined effects of wave scattering through the edge turbulence and the decreasing on energy confinement of these discharges with density. The effect of observed edge turbulence is shown to cause a broadening of the rf power deposition profile with increasing density. It is shown that the inferred value of the Ohmic ion thermal conduction, when compared to the Chang-Hinton neoclassical prediction, exhibits an increasing anomaly with increasing plasma density.

**10350 (ENEA-RT-FUS—87-29) Calculation of triton confinement and burn-up in Tokamaks.** Batistoni, P.; Anderson, D. (ENEA, Rome (Italy)). Apr 1988. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755361/JAW.

An analytical investigation is made of the confinement and subsequent burn-up of fusion produced tritons in a deuterium tokamak plasma. Explicit approximations, clearly displaying the scaling with physical parameters, are obtained for the triton confinement factor. A model loss region is developed for the evaluation of particle ripple losses. The importance of pitch angle scattering losses during the slowing down of tritons is also estimated. A comparison between experimental and numerical calculations relative to the FT tokamak shows good qualitative agreement.

**10351 (FRCEA-TH—93) Primary beams of an electron beam ion source (EBIS).** Lenoir-Zink, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service Charge de l'Entretien et du Fonctionnement de Saturne; Paris-6 Univ., 75 (France)). Jun 1986. 110p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756138/JAW.

Electron guns for the ion sources of the SATURN II facility were tested and compared with models. The guns tested were a gun with 36 mm diameter cathode, 7 mm, 4 mm, 4 mm with insulated Whenelt, and 8 mm. A lanthanium hexaboride cathode is presented. For the primary ion beams, zeolite and plasma sources were realized. In DIONE, which will replace CRYEBIS as ion source in SATURNE, the density of the electron beam compressed within the maximum magnetic field can be evaluated. Results indicate a factor of 3 improvement compared with CRYEBIS. Lithium sources can be used, but gas sources do not produce significant improvements.

**10352 (FRNC-TH—3344) Study of the MHD activity of a tokamak plasma in the lower hybrid frequency wave current generating regime.** Vallet, J.C. (Grenoble-1 Univ., 38 (France)). Jul 1986. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88756148/JAW.

Confinement by noninductive currents was investigated in experiments on MHD instability in a tokamak plasma. The change of dependence of plasma current density and resistivity as a function of electron temperature (parameters which govern the evolution of MHD instability) is stressed. Experiments on the PETULA-B tokamak allowed the determination of the nature of the instabilities (characterization of the numbers m and n for resistance tearing modes; characterization of sawtooth instabilities). Instabilities are analyzed as a function of discharges in plasma current generation by hybrid waves. On PETULA-B, the stabilisation takes two forms: stabilization of sawtooths in correlation with mode excitation (m=2, n=1); and stabilization of sawtooths by mode saturation (m=1, n=1).

**10353 (GA-A—18988) Automatic Thomson laser alignment in DIII-D.** Campbell, G.L.; DeBoo, J.C.; Evanko, R.G.; Gohil, P.; Haskovec, J.S.; Hsieh, C.L.; Snider, R.T. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 6p. (CONF-871007—132). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004028/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An automatic laser alignment system has been designed for use on the Thomson scattering profile diagnostic at DIII-D. The Thomson profile experiment is a multi-point Thomson scattering diagnostic that measures electron temperature and density along a chord through the DIII-D plasma using a Q-switched ruby laser delivering 10 J of power with a 15 ns pulse width. Long-term thermally induced changes in alignment of the laser are corrected by an automatic alignment system, thus eliminating daily manual adjust-

ment. The beam alignment is maintained in two axes at two points in the beam path. Accuracy to within 1 mm is expected at the end of a 40 m beam path. Hardware components of the system include a 5 mW CW helium-neon laser directed through an optical system which focuses on photodiode arrays at two locations. Bipolar X and Y axis error signals are derived from the diode signals by a circuit which provides constant output for a wide range of alignment beam intensity. Error signals are monitored by an STD bus microcomputer system which drives stepper motors to position mirrors aiming the laser beam. This microcomputer is programmed in BASIC with a proportional controller algorithm and subroutines for analog input and stepper motor controller co-processors. The microcomputer also supports a switch panel to manually move the mirrors. Visual verification of alignment is provided by a television camera and panel meters for the four error signals. Detailed system design of the automatic laser alignment system is presented. 3 refs., 5 figs.

10354 **(GA-A—19398) DIII-D latest results and implications.** Callis, R.; Luxon, J.; Scoville, T.; Simonen, T.; Stambaugh, R. (General Atomics Co., San Diego, CA (USA)). Nov 1988. Contract AC03-84ER51044. 6p. (CONF-881031—47). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004349/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The DIII-D tokamak has demonstrated the feasibility of the divertor configuration for future reactor relevant devices. H-mode (good) confinement has been demonstrated for deuterium discharges in both single-null and double-null divertor configurations and under a variety of heating scenarios including neutral beam injection, electron cyclotron heating, and ohmic heating. Plasma beta values ($\beta$ = 6.8%) near expected theoretical limits (3.5 I/aB) have been demonstrated. Plasma currents are limited by safety factors q > 2 near the surface of the plasma. Energy confinement improves with increasing plasma current until q decreases below 3. Divertor heat flow has been documented and initial boundary physics studies carried out. Non-inductive current drive has been demonstrated using neutral beam injection. 7 refs., 8 figs., 1 tab.

10355 **(IAEA-CN—50/A-4-4) High temperature experiments and fusion product measurements in JET.** Thomas, P.R.; Baylor, L.R.; Houlberg, W.A.; Jernigan, T.C.; Milora, S.L. (JET Joint Undertaking, Abingdon (UK)). [1988]. Contract AC05-84OR21400. 11p. (CONF-881015—33). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004804/JAW.

From 12. international conference on plasma physics and controlled nuclear fusion research; Nice, France (12 Oct 1988).

High temperature plasmas ($T_i \leqq$ 23 keV and T/sub c/ $\leqq$ 12 keV) have been obtained in JET using NBI and ICRH. The low target densities required for these experiments were produced by using graphite surfaces to pump the plasma. Low density helium pulses were employed to deplete the graphite of deuterium, thereby enhancing the pumping effect. The trapping and slowing down rates for the ICRH minority ions and d-d tritons were close to the classical values. Although the ICRH minority ions carried as much as one third of the total energy content, the thermal plasma energy confinement was unaffected by their presence. The high temperature plasmas had the same plasma energy confinement as high density, low temperature plasmas and the heating rates of hot electron and hot ion discharge were similar. These results show that the prospects are good for $\alpha$-particle heating and high temperature operation in thermonuclear plasmas. 8 ref., 5 figs.

10356 **(IAEA-CN—50/C-2-5) Advances in reversed-field pinch theory and computations.** Schnack, D.D.; Biglari, H.; Caramana, E.J.; Carreras, B.A.; Diamond, P.H.; Gang, F.Y.; Hamieri, E.; Harned, D.S.; Ho, Y.L.; McBride, J. (International Atomic Energy Agency, Vienna (Austria)). 1988. Contract AC05-84OR21400. 13p. (CONF-881015—34). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004927/JAW.

From 12. international conference on plasma physics and controlled nuclear fusion research; Nice, France (12 Oct 1988).

Significant advances have occurred in three aspects of reverse-field pinch (RFP) theory and computations: nonlinear evolution of an RFP with a resistive or distant wall; ohmic equilibria during termination; and, turbulence and transport from microinstabilities. Existing primitive and reduced nonlinear 3-D MHD codes have been modified to simulate the presence of a resistive wall. It is found that operation with a resistive wall is characterized by increases in both magnetic fluctuation amplitudes and loop voltage required for discharge sustainment. Penetration of the magnetic field through the resistive wall causes the attainable value of $\beta$/sub p/ = $8\pi p/B^2$/sub $\theta$w/ to be reduced to less than one half of that obtained with a close fitting perfectly conducting shell. Nonlinear studies of current decay and termination predict that current programming of I = I/sub o/ (1 {minus} t/t/sub o/)/sup $\alpha$/, where t/sub o/ is the rampdown time and $\alpha > 1/3$, is required to keep the drift parameter from increasing. Both theory and computations show that magnetic fluctuations are insensitive to the Lundquist number S. Hence, edge turbulence becomes important in determining confinement scaling. Studies of resistive pressure gradient turbulence yield the scaling T/sub e/ {approximately} I/sub p//sup .8/, $\beta$ {approximately} I/sub p//sup {minus}.2/ (for N {approximately} I/sub p/); studies of ion pressure gradient driven turbulence yield T {approximately} I/sub p//sup 3/4/, $\beta$ {approximately} I/sub p//sup {minus}1/4/. 14 refs., 3 figs.

10357 **(INIS-BR—1353) Non-inductive electric current generation with the Alfven waves.** Assis, A.S. de. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). 1988. 280p. (In Portuguese). NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88705151/JAW.

Non-inductive current generation by means of radio frequency waves is studied using one-dimensional (1D) quasilinear equations. The main results obtained in this thesis are the general expressions for the current generated, for the efficiency of current generation and for the critical power - the lowest power required for current saturation. (M.W.O.).

10358 (INIS-SU—60/A, pp 3-26) **Main results of the researches for controlled fusion and plasma physics in the USSR, July 1986 - July 1987.** Velikhov, E.P.; Kartashev, K.B.; Ryutov, V.D.; Cheverev, N.S. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Thermonuclear synthesis. Scientific-technical collection.

Main results of the researches for controlled fusion and plasma physics in the USSR in 1986-87 are presented. Results of experiments on tokamak T-10, T-7, Tuman-3, FT-1, FT-2 and R-0.5, Uragan-3, L-2, R-0 stellarators, open traps-gasodynamic, ambipolar, axial-symmetric PR-8, Ogra-4, KASP are discussed. Problems of plasma diagnostics, controlled fusion technical problems and pulse systems including linear theta pinch device, plasma focus, Angara-5 device are discussed. 31 figs.

10359 (INIS-SU—60/A, pp 26-30) **Optimization of ion cyclotron heating in the Tuman-3 tokamak.** Gryaznevich, M.P.; Askinazi, L.G.; D'yachenko, V.V. and others. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Thermonuclear synthesis. Scientific-technical collection.

The procedure of carrying out the ICRH experiments on the "Tuman-3" tokamak as well as the search of the optimal condition for plasma heating are described. It was found that discharge disruptions occurred to be the main obstacle in the way of increasing the RF power input. They were accompanied by the growth of the MHD activity. 8 refs.; 5 figs.

10360 (INIS-SU—60/A, pp 36-41) **Models for discharge control in tokamak with iron core.** Andreev, V.F.; Dnestrovskij, Yu.N.; Kostomarov, D.P.; Popov, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Thermonuclear synthesis. Scientific-technical collection.

The model consisting of Kirhgoff equations and the equilibrium and stability conditions is used for the discharge control in to-

kamak with iron core. The control is realized by the power supply system of the poloidal fields. The algorithm of the calculation of programming regime with prescribed plasma current scenario is proposed. The calculation results for tokamak T-15 are included. 9 refs.; 5 figs.

10361 (INIS-SU—60/A, pp 51-53) **Experiments at the Orga-4 open trap with neutral injection into the hot-electron plasma.** Belavin, M.I.; Zhil'tsov, V.A.; Kosarev, P.M. and others. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Hot-ion plasma confinement was investigated in OGRA-4 baseball-type magnetic configuration during the neutral injection into the hot-electron plasma. Plasma density in the centre of the trap amounted 5.10/sup 12/ cm/sup -3/ with $\beta$ approximately 3 %. A detail investigation of the plasma electron component behaviour which allowed to conclude that the 20 keV neutral injection is followed by accumulation of hot-ion plasma is carried out. 3 refs.; 9 figs.

10362 (INIS-SU—60/A, pp 54-57) **On the potential distribution and oscillation structure in a plasma-rotating trap.** Abdrashitov, G.F.; Bajborodin, S.I.; Bekhtenev, A.A.; Volosov, V.I.; Kubarev, V.V.; Pal'chikov, V.E.; Yudin, Yu.N. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Rotating plasma experiments in an open magnetic trap with coaxial and end electrodes are described (the electric field strength achieves 20 kV/cm). The profile of a radial electric field in a plasma is shown to coinside practically with that of the field given at the electrodes. It is also shown that the radial distribution of the electric field has great influence on the plasma stability. In the case of the decreasing-over-radius electric field, a high-frequency part of the spectrum of flute oscillations is suppressed in the plasma region with sufficiently high gradient of electric field. 3 refs.; 5 figs.

10363 (INIS-SU—60/A, pp 77-79) **New technique for electron temperature measurement in tokamaks.** Zhukovskij, V.G.; Rtishchev, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Possibility of measuring plasma electron temperature and density in T-15 tokamak device on scattering CO/sub 2/-laser radiation and on heterodine detection of scattering signal are experimentally confirmed. The advantage of suggested diagnosis is simplicity of its registration with plasma diagnosis. The incidence angle being $\Theta \simeq 1$ deg, realization of diagnosis including n/sub e/, T/sub e/ and T/sub i/ measurements is possible. 12 refs.; 2 figs.

10364 (INIS-SU—67/A, pp 17-19) **Peculiarities of near-sound flow of two-component collisionless plasma.** Movsesyants, Yu.B. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.
In Experimental and theoretical physics. Collection.

It is shown, that account of electron inertion is sufficient in near-sound zone of collisionless quasilinear plasma flows and results to occurrence of "collisionless magnetic viscosity". 6 refs.

10365 (INIS-SU—67/A, pp 14-16) **Nonlinear dynamics of instability of a plasma with a current.** Kuzelev, M.V.; Rukhadze, A.A.; Bobylev, Yu.V. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89780046/JAW.

Kratkie Soobshcheniya po Fizike.; no. 5.
In Experimental and theoretical physics. Collection.

Consideration is given to nonlinear dynamics of the resonance Buneman instability in the general nonunidimensional case. The result of Buneman instability development represents the description of electron current or the absence of such description, depending on the fulfillment of obtained criteria. 6 refs.; 1 fig.

10366 (IPPCZ—277/II, pp 16-19) **Study of spatial and temporal characteristics of the gas-puff Z-pinch.** Krejci, A.; Krousky, E.; Renner, O. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The gas-puff Z-pinch with an annular gas shell was investigated experimentally as an intensive source of soft X-rays. The temporal and spatial characteristics of the discharge were studied using a vacuum X-ray diode and a pinhole X-ray camera in the ultrasoft and the keV X-ray regions, respectively. As evident from the X-ray pinhole images, the pinch plasma decayed to several hot spots of a diameter smaller than that of the pinhole. Electron temperature as estimated from two-foil measurements fell within the range of 300-550 eV. The energy of the prevailing part of soft X-rays emitted did not exceed 100 eV. The total energy contained in the soft X-ray spectrum was some 4 J per shot, which yielded the conversion efficiency of about 1 per cent. (J.U.). 3 figs., 6 refs.

10367 (IPPCZ—277/II, pp 20-32) **Measurement of fast ions from the plasma focus device.** Denus, S.; Czekaj, S.; Szydlowski, A.; Sledzinski, S.; Wolowski, S. (Instytut Fizyki Plazmy i Laserowej Mikrosyntezy, Warsaw (Poland)). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Particle acceleration was investigated experimentally in the plasma focus devices PF-20 and PF-150. The total number of fast deuterons was determined by the carbon target activation method. Prompt neutrons from a lithium target were recorded with a scintillation counter. The energy spectra of deuterons in a single shot were analysed using a Thomson analyser. For the lower part of the ion spectra, an ion collector and the time-of-flight method were used. Stereoscopic images of the fast ion source were obtained by a set of 5 pinhole cameras with dielectric track detector plates. Deuterons of an energy of up to 5 MeV were observed; most high-energy ions were emitted from hot spots. The fast electron component up to 1 MeV was analysed with a magnetic spectrometer. (J.U.). 11 figs.

10368 (IPPCZ—277/II, pp 64-66) **Oscillating virtual cathode.** Clupek, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Nonstationary behaviour of a virtual cathode at the plasma-vacuum boundary in the oscillating beam regime was investigated using the REBEX high-current electron accelerator. Emitted electromagnetic waves and the modulation of transmitted and reflected electron beams were measured in the frequency band 2 to 12 GHz. Beam current radial profiles were recorded by means of a tiny movable current probe. The modulation frequency correlated with the frequency of radiated waves, increasing linearly with the increasing beam current. The observed frequencies lay slightly above the calculated maximum beam plasma frequency, within the range predicted by numerical simulations of a reflected beam. (J.U.). 1 fig., 2 refs.

10369 (IPPCZ—277/II, pp 107-127) **Estimates of superbanana diffusion in traps of the stellarator type with thermonuclear parameters.** Kalyuzhnyj, V.N.; Nemov, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The toroidal and poloidal radii of a plasma ring in a torsatron and a helical solenoid were estimated using the neoclassical

diffusion theory. The regimes in which the superbanana diffusion dominates were studied in particular. Both the electron and ion diffusion and the resulting radial ambipolar electric field were taken into account. In a number of cases of practical interest, the ion transport coefficients were found to be lower (and the plasma lifetime higher) than those calculated without taking account of the radial electric field. Nevertheless, the plasma ring diameter necessary for the Lawson criterion to be satisfied is still large (tens of meters). (J.U.). 2 figs., 1 tab., 15 refs.

10370 (IPPCZ—277/II, pp 128-131) **Particle confinement time during lower-hybrid current drive on CASTOR tokamak.** Badalec, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The measured increase in hydrogen and impurity ionization is too small to explain the anomalous density enhancement observed in lower hybrid current drive experiments on the CASTOR tokamak. Thus, the particle confinement time was studied. The confinement tends to improve during the start period of the lower hybrid current drive and then it drops to practically the same value as it was in the ohmic discharge. The particle confinement degradation can be explained by the anomalous Doppler instability due to the anisotropy of superthermal electron velocities. (J.U.). 1 fig., 6 refs.

10371 (IPPCZ—277/II, pp 132-136) **Impurity transport measurements in the CASTOR tokamak using collector probes and arc ignition.** Hildebrandt, D.; Juettner, B.; Purch, H.; Croetzschel, L.; Jakubka, K.; Stoeckel, J.; Zacek, F. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Elektronenphysik; Academy of Sciences of the GDR, Dresden. Central Institute of Nuclear Research; Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

A special arcing probe was used to study the tantalum impurity transport in the CASTOR tokamak. The paths of macroparticles ejected from the molten metallic surface of the arcing source were photographed with a high-speed movie camera (1000 frames per second). The photographs and the investigation of neighbouring limiters show the preferred transport of an injected material in the counter-direction of the plasma current. The long-distance transport was studied with a collector probe placed in the opposite cross-section of the tokamak. The radial dependence of materials deposited on the collector agrees with the transport of injected impurities in the co-direction of the plasma current. (J.U.). 6 figs., 5 refs.

10372 (IPPCZ—277/II, pp 158-165) **Fast ions behaviour on the CASTOR tokamak during the low density discharge with combined inductive and lower hybrid current drive.** Petrov, S.; Stoeckel, J.; Jakubka, K.; Valovic, M.; Zacek, F.; Badalec, J. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Preliminary experimental results are reported of a study in the behaviour of fast ion component in the CASTOR tokamak during the low-density inductive regime and the combined inductive-lower hybrid current drive regime are reported. The ion component in the low-density discharge was noticeably influenced by a fan-like instability. During and after the instability, an anomalous ion heating was obsered, the ion energy was well above the Artsimowitch estimate of ion temperature. In the combined regime, large scattering of experimental data due to periodical instabilities did not allow to estimate any definite slope of the ion energy spectrum. However, high energy tails with the mean energy of 300 eV were well seen in the first stable period. (J.U.). 6 figs., 7 refs.

10373 (IPPCZ—277/II, pp 180-183) **Magnetic diagnostics on CASTOR during LHCD.** Valovic, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

A standard set of magnetic diagnostic probe was used on the CASTOR tokamak. From the magnetic data, the excentricity factor and the radial and vertical positions of the outermost magnetic surface were determined. The results of magnetic measurements during a typical ohmic discharge with a subsequent lower hybrid current drive application are briefly mentioned and compared with those obtained by other diagnostic methods. (J.U.). 2 figs.

10374 (IPPCZ—277/II, pp 1-12) **Measurements on flying sodium plasma-ball created by laser blow-off.** Bakos, J.S.; Buerger, G.; Ignacz, P.N.; Szigeti, J.; Kovacs, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Jozsef Attila Tudomanyegyetem, Szeged (Hungary). Kiserleti Fizikai Intezete). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The laser blow-off from a transparent substrate into a tokamak liner was chosen as a diagnostic method for investigating the edge plasma in tokamaks. A sodium plasma flying ball was produced by evaporating a sodium layer on a rotating glass plate by means of a Q-switched neodymium laser. To gain an insight into the basic processes of ball acceleration, the time and space characteristics and the composition of the flying ball were studied using the resonance fluorescence method. The plasma ball fluorescence was induced by means of a flash lamp-pumped dye laser and detected with an eight-channel photomultiplier system. The thermal and drift velocities of the flying ball were determined for various filling pressures of argon gas in the vacuum vessel. (J.U.). 8 figs., 3 refs.

10375 (IPPCZ—277/II, pp 13-15) **Optical diagnostics of laser produced plasmas using the 3/2 ω/sub 0/ harmonic frequency.** Stirand, O. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Spectral distribution measurement at the third harmonic of the half fractional laser frequency is envisaged for the diagnostics of a plasma produced by the iodine laser Perun. Photons at this frequency are generated due to parametric instability in the region with plasma density of one quarter of the critical one. Electron temperature may directly be calculated from the spacing between two characteristic maxima, well identifiable on the line profile, while the Doppler shift of the line as a whole makes it possible to determine the hydrodynamic velocity of the plasma corona motion. (J.U.). 8 refs.

10376 (IPPCZ—277/II, pp 33-36) **Comments on the sampling of ions from negative corona discharge.** Skalny, J. (Komenskeho Univ., Bratislava (Czechoslovakia)). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Mass spectra were evaluated in a negative corona discharge between point-to-plane electrodes in dry air at a constant discharge current and at various air pressures. For the correct interpretation of mass-spectroscopic data the actual abundances of ions in the total extracted ion current must be calculated. A simple correction formula was derived for the case of Maxwell-Boltzmann distribution of ions. Reduced and non-reduced abundances of ions extracted from air at two different pressures were compared. The maximum difference between the reduced and the non-reduced data did not exceed 20 per cent. (J.U.). 3 figs., 2 refs.

10377 (IPPCZ—277/II, pp 67-68) **Four-channel Si detector for X-ray measurements.** Piffl, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

A new four-channel surface barrier detector was developed for soft X-ray measurements in a dense plasma heated with relativistic electron beams. Detector sensitivity in the range 100 to 275 eV was estimated to be 3 to 5.10/sup 10/ A/W. The detector was designed for direct operation in a high vacuum. It is therefore suitable for spectral measurements in the ultrasoft X-ray region, e.g., by using very thin zapon lacquer filters. The detector was tested in the REBEX experimental facility and the results compared with those obtained by means of vacuum photodiodes. (J.U.).

10378 (IPPCZ—277/II, pp 82-85) **Results of ultrasoft X-ray diagnostics of REBEX plasma.** Raus, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Ultrasoft X-ray detectors (vacuum photodiodes) and submicrometer nitrocellulose filters were used for the electron temperature measurements of an electron beam-heated plasma in the REBEX machine. The relatively high X-ray intensity observed can be explained by the influence of impurity lines with carbon as a prevailing impurity. In the dense plasma region (10/sup 15/ to 10/sup 16/ cm/sup -3/) the plasma bulk temperature was estimated to be 12 eV, with a slight trend towards increasing even after the termination of beam injection. In the lower density region (10/sup 14/ to 10/sup 15/ cm/sup -3/), the electron temperature of the bulk exceeded some 50 eV. The soft X-ray data well correlate with the diamagnetic data. In both regimes, a relatively high fraction of overthermal electrons was evidently present. (J.U.). 3 figs., 4 refs.

10379 (IPPCZ—277/II, pp 148-157) **Li-beam diagnostics of the tokamak edge plasma.** Weixelbaum, L.; Hayesz, E.; Wenzel, U.; Krebs, K.H. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Elektronenphysik). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Of the diagnostic methods for tokamak edge plasmas, the corpuscular method exploiting the neutral beam of lithium atoms proved to be particularly suitable. The principles and possibilities of the lithium beam method are discussed in general. Three main beam types used in tokamak experiments (a fast beam, laser-induced evaporation, and a thermal beam) are characterized from the point of view of their interaction with a plasma. Finally, the thermal lithium beam experiment installed on the CASTOR tokamak is described in detail. (J.U.). 3 figs., 9 refs.

10380 (IPPCZ—277/II, pp 166-179) **Analyzers of atomic particles for corpuscular plasma diagnostics.** Shustov, I.V. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The basic principles of corpuscular plasma diagnostics are briefly summarized and the possibilities of passive corpuscular methods are discussed in general. Neutral atom analyzers used in tokamak experiments are classified with respect to the ionization method used, and different schemes of analyzers are described. A new version of the analyzer Lakmus developed by FTI A.F.Ioffe for the T-15 tokamak was chosen to demonstrate the latest technical progress in the neutral atom analyzer design. The Lakmus-2 analyzer makes it possible to measure simultaneously both the hydrogen and the deuterium energy spectra in a broad range of energies (up to 200 keV) and with high energy and time resolution (2x24 channels, 1 ns). The enhanced number of channels and the high detection sensitivity was achieved due to the application of microchannel plate detectors. (J.U.). 8 figs., 11 refs.

10381 (IPPCZ—277/II, pp 93-97) **Resonance absorption of energy by a plasma with a continuous spectrum of eigenfrequencies.** Sedlacek, Z.; Roberts, B. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; Saint Andrews Univ. (UK)). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Active and reactive power resonantly absorbed by a linear passive plasma system was calculated in terms of its continuum eigenfunctions and spatial-temporal spectral density of an external force. The system studied was assumed to be conservative, with the state vector obeying a Lagrangian set of equations. The external force was a stationary random field. It was shown that only those spectral components of the external force which fell within the system spectrum contributed to the absorbed power. The formalism derived was applied to the TM electromagnetic wave interacting with a cold inhomogeneous plasma. The resulting formulas for the absorbed power were compared with those obtained by other authors. (J.U.). 7 refs.

10382 (IPPCZ—277/II, pp 101-106) **K-modes of a plasma with Maxwellian distribution of particle velocities in magnetic field.** Egorenkov, V.D.; Stepanov, K.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Additional highly damped branches of plasma oscillations arising due to purely kinetic effects (K-modes) in a magnetized plasma were theoretically investigated. Both the potential (ion-sound, ion-cyclotron) and the non-potential (electromagnetic and ion-cyclotron) low-frequency K-modes were studied in detail, the corresponding dispersion relations were derived and solved analytically. A similar group of additional kinetic branches also existed in the high frequency range (magnetized electron-acoustic and electron-cyclotron K-modes). (J.U.). 2 refs.

10383 (IPPCZ—277/II, pp 137-143) **Stochasticity threshold of the interaction of the monochromatic Alfven wave with trapped particles in tokamaks.** Krlin, L.; Pavlo, P.; Tluchor, Z.; Gasek, Z. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The interaction of monochromatic Alfven waves with toroidally trapped particles in tokamaks, in the regime of intrinsic stochasticity, was investigated theoretically. The velocity and radial position changes of banana regions due to the instability in question were studied for both the plasma electrons and thermonuclear alpha particles. As for the electrons, random banana motions were found for wave fields higher than 100 V/m; they were illustrated by numerical results. The induced radial diffusion exceeded neoclassical diffusion. On the other hand, at least for realistic wave amplitudes, alpha particles did not enter a larger scale stochasticity. (J.U.). 6 figs., 5 refs.

10384 (IPPCZ—277/II, pp 144-147) **Generation of higher spatial harmonics at lower hybrid heating.** Pavlo, P.; Petrzilka, V.A. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The problem of higher spatial harmonics generation during high-frequency current drive in tokamaks is studied numerically on a simplified model. It is assumed that only the first harmonic is ra-

diated by the grill, the higher ones are nonlinearly generated by its dispersion at induced density modulations. The choice of parameters in calculations is related to the T-7 experiment. The higher harmonics have electric fields by four to five orders of magnitude lower than the first one. As for the odd harmonics, the amplitude decreases rapidly with the harmonic number, as illustrated by pictures. From the results it may be concluded that the generation of the fourth and higher harmonics is of negligible importance for the high-frequency current drive. (J.U.). 4 figs., 3 refs.

10385 (IPPCZ—277/II, pp 184-188) **Dynamics of soliton formation from random Langmuir waves.** Breizman, B.N.; Jungwirth, K. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki; Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

Nonlinear processes accompanying the Langmuir turbulence, namely the soliton formation and plasmon trapping, are studied. From analytical estimates and numerical studies, a full scenario of the soliton formation from a random supersonic plasmon field was obtained. The direct soliton formation from the initial plasmon spectrum took also place below the threshold of the modulation instability. The first-generation solitons arose in this way only trapped long-wavelength plasmons. Larger second-generation solitons were formed predominantly due to self-trapping of fluctuations. Most of the trapped plasmons belonged to the dominant set of slow solitons of a comparable size and spacing determined by their instantaneous formation length. (J.U.). 9 refs.

10386 (IPPCZ—277/II, pp 98-100) **LH current drive in CASTOR.** Badalec, J.; Datlov, J.; Jakubka, K.; Kopecky, V.; Kryska, L.; Magula, P.; Preinhaelter, J.; Stoeckel, J.; Valovic, M.; Zacek, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jul 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

In order to check the influence of the antenna spectrum on the current drive efficiency high-frequency power was coupled to the CASTOR tokamak plasma by means of two multijunction grills with four and seven waveguides, respectively. The results of the following three experiments are reported: A short RF pulse application during the quasistationary phase of tokamak discharge, a long RF pulse application into a decaying plasma, and non-inductive plasma generation with a subsequent lower hybrid current drive. In none of these experiments did the character of plasma-wave interaction depend on the grill type. This suggests the spontaneous production of short-wavelength spectral components, e.g., due to peripheral plasma fluctuations. (J.U.). 6 refs.

10387 **(IPPJ—870) Neon puffing experiments in the JIPP T-IIU tokamak.** Meservey, E.; Toi, K.; Ando, R. and others. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756050/JAW.

Large amounts of neon have been puffed into the discharge of the JIPP T-IIU tokamak, producing values of effective ion charge, Z/sub eff/, as large as 6 or 7 at linear average electron density n-bar/sub e/, up to 3.5 x 10/sup 13/ cm/sup -3/. Electron temperatures, T/sub e/, rise to about twice those obtained in hydrogen puffing discharges that have the same current and elctron density time behavior. Energy containment times are about the same for the neon and hydrogen puffing cases. At high values of Z/sub eff/, there appears to be a difference between the value of Z/sub eff/ calculated from the n-bar/sub e/ produced by neon puffing and the values calculated from Spitzer conductivity corrected for trapped electron effects. Brightness of Ne V, VIII, and IX lines and total radiated power have been calculated (using a multi-ion species transport code assuming an ion diffusion constant of 1 x 10/sup 4/ cm/sup 2/ sec/sup -1/ for all neon charge states) from temperature and density profiles and the estimated amount of neon in the discharge. These calculations agree well with measured values, except at the highest value of n-bar/sub e/ and Z/sub eff/, where the calculated power is twice that measured.

10388 **(IPPJ—872) Excitation of MHD surface waves propagating with shear Alfven waves in an inhomogeneous cylindrical plasma.** Amagishi, Y.; Saeki, K.; Donnelly, I.J. (Shizuoka Univ. (Japan). Faculty of Liberal Arts). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756052/JAW.

Experimental results are presented which show that the MHD surface waves or fast waves of m = +-1 have been excited in the range of frequency less than ion cyclotron frequency using a helical antenna in a finite $\beta$ and cylindrical plasma. Their dispersion relation and spatial structure were successfully confirmed after the wave signals were separated from those of the local shear Alfven waves that propagated together with the surface waves. In order to obtain the dispersion relations from the signals, we adopted three kinds of method; (1) conventional cross-power spectrum density using fast Fourier transform, (2) maximum entropy method, and (3) direct estimation of the phase velocity of wave packets.

10389 **(IPPJ—874) High intensity Li beams for beam probe laser spectroscopy.** Yamaoka, Hitoshi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756054/JAW.

High intensity Li beams which include the laser blow-off beam and the fast beam have newly been developed for plasma diagnostics with the combination of beam probe and laser spectroscopy, especially for the measurement of magnetic field strength. Characteristics of the beam are investigated for checking their applicability as diagnostic beams. A novel technique has been developed to measure the magnetic field strength based on the laser blow-off Li beam probing combined with Dopper-tuned laser spectroscopy. A low energy beam is produced with a simple laser blow-off method. The density of Li beam produced by blowing off a thin Li film is of the order of 10/sup 10/ cm/sup -3/, which is measured by laser-induced fluorescence method. The beam energy is found to have a nearly Maxwellian velocity distribution which has a translational energy of a few eV. A Li ion source of a discharge type was used to produce a high energy and high current beam. A Li beam of a few mAcm/sup -2/ with the minimum beam divergence of 1.2 deg is produced at the beam energy of 12 keV. By measuring beam intensity and divergence it is found that a beam of good quality with the minimum divergence and the maximum current can be obtained simultaneously for a given energy when the negative potential is set to an optimum value. The divergence decreases with the beam energy, but increases after it takes the minimum value. A neutralization efficiency of about 80 % can be obtained with Na vapor cell without difficulty. Applicability of the fast beam to the measurements of impurity ion densities is discussed. For the measurement of the magnetic field strength the same principle as the case of the laser blow-off beam with Doppler-tuned laser spectroscopy is applicable to the fast beam by slightly modulating the beam velocity. The energy modulation of about a few % does not deteriorate the quality of the beam. Limits of the measurements are also described. (J.P.N.) 62 refs.

10390 **(IPPJ—875) Theory of high power cyclotron resonance heating in non-uniform magnetic field.** Sugihara, Ryo; Ogawa, Yuichi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756055/JAW.

Energy absorption of a plasma due to cyclotron harmonic resonance is evaluated analytically and by a simulation. In the calculation an orbit modification of the cyclotron motion of particles is fully taken into account. It is found that the absorption for the fundamental harmonic resonance (m = 1) is depressed from that of the conventional linear approximation while the absorptions for m $\geqq$ 2 are enhanced, where m is the harmonic number. The enhancement is significant when kRHO/sub t/ $<<$1 (k the perpendicular wave number and RHO/sub t/ the gyroradius of a thermal particle) and when the interaction time between the plasma particles and the wave exceeds a critical value that is obtainable analytically. For all

m and kRHO/sub t/, there appear peaks or saturations in the absorption. The second harmonic ion cyclotron resonance heating experiment in Princeton Large Tokamak is discussed in terms of this theory.

10391 **(IPPJ—876) Comparison between Uramoto type and straight filament type sheet plasmas as a volume produced H/sup -/ ion source, (1).** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756056/JAW.

The Uramoto type sheet plasma (transformed from a cylindrical plasma by two permanent magnets) and a long straight filament cathode type sheet plasma are compared as volume produced H/sup -/ ion sources. For a same discharge power (for example 5 A x 100 V = 500 W), a H/sup -/ ion current density (2.5 mA/cm/sup 2/) extracted from the Uramoto type sheet plasma, is above 20 times larger than that from the straight filament type (0.125 mA/cm/sup 2/). As an essential difference between the two types, it is pointed out that the Uramoto type uses in combination of negative bias voltage on the metalic large vacuum chamber (surrounding the sheet plasma) and a cusp magnetic field produced by the two permanent magnets which are effective on the confinement of electrons and H/sup -/ ions. A pressure gradient discharge of the ordinary Uramoto type is not essential for volume production of H/sup -/ ions, but is very useful to reduce the optimum pressure.

10392 **(LA-UR—88-3375) Update of RFP scaling data.** DiMarco, J.N. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-881015—32). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002243/JAW.

From 12. international conference on plasma physics and controlled nuclear fusion research; Nice, France (12 Oct 1988).

Four years have passed since the writing of the ZTH technical proposal. In the interim three new or modified RFP experiments have added to the energy confinement time ({tau}/sub E/) data base. This report updates the {tau}/sub E/ scaling information by including the new data, compares the data to theoretical predictions, and makes extrapolations to ZTH and TITAN parameters. The first section of this report presents a brief description of the theoretical scaling predictions. The next section presents the experimental data and scaling results, and the last section discusses the results and their implications. 17 refs., 2 figs., 2 tabs.

10393 **(LA-UR—88-3761) Recent theoretical studies of internal structure and stability of field-reversed configurations.** Webster, R.B.; Lewis, H.R.; Staudenmeier, J.L.; Milroy, R.D.; Barnes, D.C.; Bishop, R.C.; Spencer, R.L.; Xu, Y.H.; Matheson, P.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-8811106—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003487/JAW.

From 10. US/Japan CT workshop; Hakone, Japan (14 Nov 1988).

In this paper we present the results of recent examinations of the low frequency, large scale stability of the field-reversed configurations (FRC). We also examined the ability to accurately infer internal transport quantities (e.g., field null resistivity) in an FRC. 7 refs., 5 figs.

10394 **(PB—89111546/XAB) Low-frequency MHD instability in a hot-electron plasma. Technical report.** Huang, C.; Ren, Z.; Qiu, L. (Academia Sinica, Hefei, AH (China). Inst. of Plasma Physics). 1987. 9p. NTIS, PC E03/MF A01.

Low-frequency interchange instability in a hot-electron plasma is studied. Line-tying of conducting end plates is considered. A dispersion relation is derived. Stability criteria are found.

10395 **(PPPL—2551) Transport and stability studies on TFTR.** McGuire, K.M.; Arunasalam, V.; Barnes, C.W.; Bell, M.G.; Bitter, M.; Bosch, H.S.; Bretz, N.L.; Budny, R.; Bush, C.E.; Cavallo, A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1988. Contract AC02-76CH03073. 21p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004618/JAW.

During the 1987 run, TFTR reached record values of Q/sub DD/, neutron source strength, and T/sub i/(0). Good confinement together with intense auxiliary heating has resulted in a plasma pressure greater than 3 x $10_5$ Pascals on axis, which is at the ballooning stability boundary. At the same time improved diagnostics, especially ion temperature profile measurements, have led to increased understanding of tokamak confinement physics. Ion temperature profiles are found to be much more peaked than previously thought, implying that ion thermal diffusivity, even in high ion temperature supershot plasmas, is greater than electron thermal diffusivity. Based on studies of the effect of beam orientation on plasma performance, one of the four neutral beamlines has been re-oriented from injecting co-parallel to counter parallel, which will increase the available balanced neutral injection power from 14 MW to 27 MW. With this increase in balanced beam power, and the addition of 7 MW of ICRF power it is planned to increase the present equivalent Q/sub DT/ of 0.25 to close to break-even conditions in the coming run. 26 refs., 10 figs.

10396 **(PPPL—2558) Neutron sawtooth behavior in the PLT, DIII-D, and TFTR tokamaks.** Lovberg, J.A.; Heidbrink, W.W.; Strachan, J.D.; Zaveryaev, V.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1988. Contract AC02-76CH03073. 58p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004619/JAW.

The effect of the sawtooth instability on the 2.5 MeV neutron emission in the PLT, DIII-D, and TFTR tokamaks is studied. In thermonuclear plasmas, the instability typically results in a 20% reduction in emission. The time evolution of the thermonuclear neutron signal suggests that the sawtooth crash consists of four phases. First, the electron density profile flattens rapidly (in {approximately}30$\mu$sec on PLT) but, in some cases, there is little associated change in neutron emission, suggesting that most reacting ions remain confined in the sawtooth region but do not completely mix. After the electron sawtooth, the ions continue to mix, resulting in a {approximately}10% reduction in neutron emission in {approximately}0.5 msec. The emission then decays more slowly during the final two phases. Thermalization of reacting ions on a {approximately}3{tau}/sub ii/ time scale accounts for only {approximately}20% of the slow drop. Most of the slow drop seems to be caused by loss of ion energy from the mixing region (an ion heat pulse). 36 refs., 15 figs., 1 tabs.

10397 **(PPPL—2559) Four-channel ZnS scintillator measurements of escaping tritons in TFTR.** Zweben, S.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1988. Contract AC02-76CH03073. 39p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004620/JAW.

A four-channel scintillation detector capable of measuring tritons, protons, and alphas escaping from a tokamak plasma was operated during the 1986 run period of the Tokamak Fusion Test Reactor (TFTR). Signals consistent with the expected 1 MeV triton behavior have been observed during deuterium operation. Backgrounds associated with neutrons, gammas, and soft x-rays have been evaluated in situ. Such a detector should be capable of measuring escaping alphas during the D/T phase of TFTR. 16 refs., 10 figs.

10398 **(PPPL—2560) Local carbon diffusion coefficient measurement in the S-1 spheromak.** Mayo, R.M.; Levinton, F.M.; Meyerhofer, D.D.; Chu, T.K.; Paul, S.F.; Yamada, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1988. Contract AC02-76CH03073. 41p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004621/JAW.

The local carbon diffusion coefficient was measured in the S - 1 spheromak by detecting the radial spread of injected carbon impurity. The radial impurity density profile is determined by the balance of ionization and diffusion. Using measured local electron temperature T/sub e/ and density n/sub e/, the ionization rate is determined from which the particle diffusion coefficient is inferred. The results found in this work are consistent with Bohm diffusion. The absolute magnitude of D/sub {perpendicular}/ was determined to be (4{approximately}6) {times} D/sub Bohm/. 25 refs., 13 figs., 2 tabs.

10399 **(PPPL—2563) Alpha particle confinement in tokamaks.** White, R.B.; Mynick, H.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 12p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004624/JAW.

An assessment of diffusive tokamak transport mechanisms of concern for alpha particles indicates that the "stochastic regime" is the only one which appears to pose a real danger for adequate alpha confinement. This fact, in conjunction with the threshold character of that mechanism, allows one to decide whether an alpha born at a given location will be lost or confined, according to a very simple criterion. Implementing this criterion numerically results in a new code for the assessment of alpha confinement, which is orders of magnitude faster than earlier codes used for this purpose. 13 refs., 3 figs., 1 tab.

10400 **(PPPL—2565) Properties of ion temperature gradient drift instabilities in H-mode plasmas.** Hahm, T.S.; Tang, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004626/JAW.

Experimental results from tokamaks such as DIII-D and JET have indicated that the electron density profile in H-mode ("high-confinement") discharges can be nearly flat over most of the plasma, and, in some cases, even inverted (outwardly peaked). These conditions have very interesting implications for pictures of anomalous thermal transport based on the presence of ion temperature gradient drift instabilities. The present paper includes a new derivation of the ion temperature gradient threshold for weak density gradient {eta}/sub i/ modes when ion transit resonances are taken into account; and the first derivation of threshold conditions for the onset of {eta}/sub i/-modes when {eta}/sub i/ is negative along with the properties of these negative {eta}/sub i/ instabilities when the thresholds are exceeded. Possible consequences for confinement in H-mode plasmas are discussed. 32 refs., 8 figs.

10401 **(PPPL—2566) Approximation for nonresonant beam target fusion reactivities.** Mikkelsen, D.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004627/JAW.

The beam target fusion reactivity for a monoenergetic beam in a Maxwellian target is approximately evaluated for nonresonant reactions. The approximation is accurate for the DD and TT fusion reactions to better than 4% for all beam energies up to 300 keV and all ion temperatures up to 2/3 of the beam energy. 12 refs., 1 fig., 1 tab.

10402 **(PPPL—2567) Gain measurements at 182 {angstrom} in C VI generated by a Nd/glass laser.** Kim, D.; Skinner, C.H.; Umesh, G.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004628/JAW.

We present recent gain measurements in C VI at 182 A for a soft x-ray amplifier produced by a line-focused glass laser(1.053 μm) on a solid carbon target. The maximum gain measured was 8 +- 1 cm/sup {minus}1/ in the recombining plasma column with additional radiation cooling by iron impurities. 10 refs., 3 figs.

10403 **(PPPL—2569) Gyrokinetic energy conservation and Poisson-bracket formulation.** Brizard, A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004630/JAW.

An integral expression for the gyrokinetic total energy of a magnetized plasma with general magnetic field configuration perturbed by fully electromagnetic fields was recently derived through the use of a gyro-center Lie transformation. We show that the gyrokinetic energy is conserved by the gyrokinetic Hamiltonian flow to all orders in perturbed fields. This paper is concerned with the explicit demonstration that a gyrokinetic Hamiltonian containing quadratic nonlinearities preserves the gyrokinetic energy up to third order. The Poisson-bracket formulation greatly facilitates this demonstration with the help of the Jacobi identity and other properties of the Poisson brackets. 18 refs.

10404 **(PPPL—2571) Rf sheaths and impurity generation by ICRF [ion cyclotron range of frequencies] antennas.** Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004632/JAW.

In general, Faraday screen elements in an ICRF antenna are not aligned precisely along the combined toroidal and poloidal magnetic fields. When plasma of density $n > 2\epsilon_0 V/eg^2$ {approximately} $10^9 cm^{-3}$ is present in the gap between elements, electron response to the parallel electric field shorts out the electric field over most of the gap, leaving a narrow sheath of positive space charge and intense electric field. Here V denotes the voltage across the gap and g the gap spacing. This intense electric field accelerates ions up to an appreciable fraction of the gap voltage ({approximately} 1 kV), sufficient to cause physical sputtering of the screen material. Impurities so generated constitute the principal limitation on power density ($kW/cm^2$) for ICRF antennas. ICRF antenna and Faraday screen design principles which minimize sputtering are discussed. 24 refs., 9 figs., 1 tab.

10405 **(PPPL—2573) Ion thermal confinement in the TFTR enhanced confinement regime.** Fonck, R.J.; Howell, R.; Jaehnig, K.; Roquemore, L.; Schilling, G.; Scott, S.; Zarnstorff, M.C.; Bitter, M.; Bush, C.; Goldston, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073. 13p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004634/JAW.

Measurements of the plasma ion temperature and toroidal rotation speed profiles have allowed the study of ion thermal transport in the TFTR hot ion enhanced confinement regime. Central ion temperatures up to 30 keV and rotation speeds up to $8 \times 10^5$ m/sec have been confirmed with new diagnostic measurements, and the ion thermal diffusivity is found to be non-neoclassical and comparable to the anomalous electron thermal diffusivity. The dominant effects of strong rotation are the down-shifting of the neutral beam energies in the plasma frame, which results in reduced ion and electron heating on axis, and the presence of off-axis ion heating from viscous damping of the plasma rotation. 14 refs., 3 figs.

10406 **(UCRL—21136) Nonlinear rf [radiofrequency] processes in plasma.** Morse, E.C. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004071/JAW.

The following report describes the activities carried out at Berkeley under contract with Lawrence Livermore Laboratory in the area of nonlinear rf studies. The two-year contract with Lawrence Livermore Laboratory had as its mission the development of ray tracing theory and computer simulation techniques that could be applied to nonlinear radiofrequency (rf) wave propagation problems. Three specific tasks were outlined in the initial proposal for this contract: to formulate the basic equations of Hunter and Keller into a set of equations which can be used to solve electromagnetic propagation problems in nonlinear media, to apply this formalism to possible forms of nonlinearity involved in lower hybrid wave propagation in compact torus plasma, and to establish a computer code which can solve the nonlinear ray tracing equations generated from task 1. This report is organized into three sections. Each section contains the most important results in each of the three areas outlined above. A section of comments and conclusions follows. 4 figs.

10407 **(UCRL—53871) Parametric analysis of the thermal effects on the divertor in tokamaks during plasma disruptions.** Bruhn, M.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 136p. NTIS, PC A08/MF A01 - OSTI. Order Number DE89004988/JAW.

Plasma disruptions are an ever present danger to the plasma-facing components in today's tokamak fusion reactors. This threat results from our lack of understanding and limited ability to control this complex phenomenon. In particular, severe energy deposition

occurs on the divertor component of the double-null configured tokamak reactor during such disruptions. A hybrid computational model developed to estimate and graphically illustrate global thermal effects of disruptions on the divertor plates is described in detail. .The quasi-two-dimensional computer code, TADDPAK (Thermal Analysis Divertor during Disruptions PAcKage), is used to conduct parametric analysis for the TIBER II Tokamak Engineering Test Reactor Design. The dependence of these thermal effects on divertor material choice, disruption pulse length, disruption pulse shape, and the characteristic thickness of the plasma scrape-off layer is investigated for this reactor design. Results and conclusions from this analysis are presented. Improvements to this model and issues that require further investigation are discussed. Cursory analysis for ITER (International Thermonuclear Experimental Reactor) is also presented in the appendix. 75 refs., 49 figs., 10 tabs.

10408 **Role of small-impact-parameter electron-loss processes on ion temperatures measured by active-beam plasma diagnostics.** Donne, A.J.H.; de Heer, F.J.; Olson, R.E. (Association Euratom: FOM, FOM: Instituut voor Plasmafysica, Rijnhuizen, P.O. Box 1207, 3430 BE Nieuwegein, The Netherlands). *Journal of Applied Physics;* **65**: No. 1, 57-63(1 Jan 1989).

The shape of the energy distribution of scattered particles in an active-beam scattering experiment can be influenced considerably by the presence of highly charged impurity ions in the plasma. In this work it is shown theoretically that multiply charged impurities have only a small effect on the scattering distribution at low energies (<10 keV/amu) and at high energies (>75 keV/amu). The effect of the impurities is the most pronounced for energies close to 50 keV/amu. The results of the calculations are in good agreement with experimental results at various energies. Extrapolation to higher beam energies leads to the conclusion that the active-beam scattering diagnostics can be applied also in future fusion devices for measuring the local ion temperature.

10409 **Theory of ion-hose instability.** O'Brien, K.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 1, 9-16(1 Jan 1989).

Solutions are derived for the partial-differential equations of the rigid model of ion hose with and without an applied axial magnetic field. An upper bound on the amplitude of the beam response, derived from these exact solutions, is compared with the upper bound derived by means of an asymptotic saddle-point calculation. In the exact solutions, explicit boundary conditions are retained. The details of the boundary conditions are significant in understanding the driven ion-hose instability in the experiments. Consideration of the effects of a magnetic field is important because in the ion-hose experiments at Sandia National Laboratories the beam is immersed in an applied axial-magnetic field.

10410 **Nonlinear focusing of coupled waves.** McKinstrie, C.J.; Russell, D.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 26, 2929-2932(26 Dec 1988).

The collinear propagation of an arbitrary nimber of finite-amplitude waves is modeled by a system of coupled nonlinear Schroedinger equations. This model incorporates the effects of a coordinate-dependent external potential and coordinate-independent nonlinearities. A virial theorem is derived, which governs the nonlinear focusing of these coupled waves. For two light waves in a beat-wave accelerator, the coupling to each other and to the resonantly generated Langmuir wave has a significant effect on the focusing properties of the waves.

10411 **Time-resolved measurement of coronal temperature and line-intensity profiles in laser-produced plasmas.** Young, B.K.F.; Stewart, R.E.; Cerjan, C.J.; Charatis, G.; Busch, G.E. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **61**: No. 25, 2851-2854(19 Dec 1988).

Time-resolved electron temperature and line-intensity profiles in laser-produced plasmas have been measured for the first time with an x-ray framing camera. Temperature profiles measured from the slope of the free-bound recombination continuum in AlXIII ions are significantly lower than hydrodynamic model calculations. Simultaneous interferometric density measurements are in much closer agreement with computer simulations. Spectral line-intensity profiles have also been measured and cannot be described by standard collisional radiative equilibrium models.

10412 **Relaxation phenomena in the high-temperature S-1 spheromak.** Ono, Y.; Ellis R.A. Jr.; Janos, A.C.; Levinton, F.M.; Mayo, R.M.; Motley, R.W.; Ueda, Y.; Yamada, M. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey 08543). *Physical Review Letters;* **61**: No. 25, 2847-2850(19 Dec 1988).

Operation of the S-1 device in a high—current-density (j/n/sub e/≧2 x 10/sup -14/ A m) regime has created high—electron-temperature spheromaks (50 ev ≦T/sub e/≦130 eV). The mechanisms and causes of the periodic relaxation events often observed in these hotter plasmas were made clear. A relationship between the MHD relaxation cycle and confinement was revealed for the first time. Resistive loss at the outer edge causes a departure from the initial force-free minimum-energy Taylor state to an MHD profile unstable to low-n ideal MHD modes; a relaxation event then returns the configuration to a Taylor state.

10413 **Finding plasma equilibria with magnetic islands.** Miller, G.; Faber, V.; White A.B. Jr. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **79**: No. 2, 417-435(Dec 1988).

The traditional method of solving the helically symmetric plasma equilibrium equation, of the form L[G] = F(G, r) where L is an elliptic linear operator, has been the simple iteration L[G/sup n//sup +1/] = F(G/sup n/, r). A model of a Tokomak equilibrium is constructed and used to illustrate the divergence of the simple iteration for plasma equilibria with magnetic islands. Although the problem of equilibria with magnetic islands is two dimensional, for small islands the numerical stability of the simple iteration may be analyzed using a one-dimensional equation similar to the linearized equilibrium equation used to analyze physical (resistive) instability. This analysis is used to prove that any equilibria of the Tokamak type with small islands cannot be obtained by the simple iteration and to illustrate the superlinear convergence of Newton's method on these problems. The implementation of Newton's method is discussed and examples are given. copyright 1988 Academic Press, Inc.

10414 **Topical Conference on High Temperature Plasma Diagnostics, 7th, Napa, CA, Mar. 13-17, 1988, Proceedings.** Luhmann, N.C. Jr.; Peebles, W.A. (California Univ., Los Angeles (USA)). *Review of Scientific Instruments;* **59**: vp(Aug 1988). (CONF-880364—).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Various papers concerning scientific instruments are presented. The general topics addressed include: laser scattering and optical diagnostics, collective scattering and interferometry, millimeter wave and current profile measurements, particle-based diagnostics, data acquisition and analysis, X-ray diagnostics, and particle- and photon-based diagnostics. Individual subjects discussed include: atomic hydrogen density measurements in an ion source plasma using VUV absorption spectrometer, resonant diagnostics of laser-produced Ba plasmas, radiative and diffusional effects to the population densities of the excited-state atoms in hydrogen plasma, and Watt-level millimeter-wave monolithic diode-grid frequency multipliers.

10415 **Pulsed laser stereophotography of plasmas and dynamically moving surfaces.** Paisley, D.L. (Los Alamos National Lab., M-7, Mail Stop P950, P.O. Box 1663, Los Alamos, NM (US)). pp 193-197 of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

A pulsed laser is used as a light source for illuminating the surface of a dynamic event of <1 mm/sup 2/ moving at >3 mm//

μs. At a predetermined time during the dynamic action, a stereo camera is used to record a pair of images of the dynamically moving surface. The stereoimage pair can be quantified for surface contour.

10416 **Alfven wave studies on a tokamak.** Kortbawi, D. Madison, WI; Univ. of Wisconsin (1987). 151p. University Microfilms Order No. 87-27,239.

Thesis (Ph. D.).

The continuum modes of the shear Alfven resonance are studied on the Tokapole II device, a small tokamak operated in a four-node poloidal-divertor configuration. A variety of antenna designs and the efficiency with which they deliver energy to the resonant layer are discussed. The spatial structure of the driven waves is studied by means of magnetic probes inserted into the current channel. In an attempt to optimize the coupling of energy in to the resonant layer, the angle of antenna currents with respect to the equilibrium field, antenna size, and plasma-to-antenna distance are varied. The usefulness of Faraday shields, particle shields, and local limiters are investigated. Driving-antenna currents parallel to the equilibrium field (which would directly drive the shear Alfven wave) leads to large parasitic loading, due to the wave electric field being heavily attenuated in the edge of the plasma. Antenna currents perpendicular to the equilibrium field (which drive the fast wave which couples to the shear Alfven wave at the resonant surface) more efficiently delivers energy to the resonant surface. Antennas should be well shielded, either a dense Faraday shield or particle shield being satisfactory. The antenna should be large and very near to the plasma.

10417 **Energy distribution and transfer in flowing hydrogen microwave plasmas.** Chapman, R.A. East Lansing, MI; Michigan State Univ. (1987). 226p. University Microfilms Order No. 88-01,797.

Thesis (Ph. D.).

This thesis is an experimental investigation of the physical and chemical properties of a hydrogen discharge in a flowing microwave plasma system. The plasma system is the mechanisms utilized in an electrothermal propulsion concept to convert electromagnetic energy into the kinetic energy of flowing hydrogen gas. The plasmas are generated inside a 20-cm ID resonant cavity at a driving frequency of 2.45 GHz. The flowing gas is contained in a coaxially positioned 22-mm ID quartz discharge tube. The physical and chemical properties are examined for absorbed powers of 20-100 W, pressures of 0.5-10 torr, and flow rates of 0-10,000 μ-moles/sec. A calorimetry system enclosing the plasma system to accurately measure the energy inputs and outputs has been developed. The rate of energy that is transferred to the hydrogen gas as it flows through the plasma system is determined as a function of absorbed power, pressure, and flow rate to +/-1.8 W from an energy balance around the system. The percentage of power that is transferred to the gas is found to increase with increasing flow rate, decrease with increasing pressure, and to be independent of absorbed power.

10418 **Experimental study of time-varying current flow between electrodes immersed in a laboratory magnetoplasma.** Urrutia Paez, J.M. Los Angeles, CA; Univ. of California (1987). 144p. University Microfilms Order No. 88-02,514.

Thesis (Ph. D.).

The flow of current between electrodes immersed in plasmas is a topic of fundamental importance in the operation of plasma probes, plasma confinement research, and space-based experiments. To date, however, research has been limited to time-stationary treatments of the regions immediate to the electrodes themselves. For the case of non-emitting electrodes, positive and negative charge carriers are predicted to flow from the entire plasma into the oppositely charged electrodes, while only one species is involved if one of the electrodes emits charged particles. If the charge carriers are magnetized, the current flow is restricted to the reattachment point, resulting in a more-efficient data acquisition and it providing a detailed description of the instantaneous spatial relationship of the flow field. Intense studies were conducted using a 2.9-Hz sinusoidal flow with a frequency parameter of 7.5 and with mean and modulation Reynolds numbers of 575 and 350, respectively. For flow through mild occlusions, a 45% axisymmetric and a 38% asymmetric stenoses, the flow-separation pattern displayed oscillation of both the separation boundary and the reattachment point with some nonperiodic components.

10419 **Tokamak plasma interaction with limiters.** Pitcher, C.S. Ontario, Canada; Univ. of Toronto (1987). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

The importance of plasma purity is first discussed in terms of the general requirements of controlled thermonuclear fusion. The tokamak approach to fusion and its inherent problem of plasma contamination are introduced. A main source of impurities is due to the bombardment of the limiter by energetic particles and thus the three main aspects of the plasma-limiter interaction are reviewed, boundary plasma conditions, fueling/recycling and impurity production. The experimental program carried out on the DITE tokamak at Culham Laboratory, UK is described. The experiments investigated these three topics and the results are compared with predicted behavior; new physical phenomena are presented in all three areas. Simple one-dimensional fluid equations are found to adequately describe the SOL plasma, except in regard to the presheath electric field and ambipolarity; in the latter, local flow conditions are generally nonambipolar. Recycling of fuel particles from the limiter is observed to be near unity at all times. The break-up behavior of recycled and gas-puffed $D_2$ molecules is dependent on the electron temperature, as expected. Impurity production at the limiter is dominated by fuel-species physical sputtering, with deuterium chemical erosion of graphite being negligible.

10420 **Radio-frequency fields around conductors in plasma.** Morin, G.A. Ontario, Canada; Univ. of Toronto (1987). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

The effects of the ion sheath on the RF properties of conductors in an isotropic plasma are investigated. A warm plasma model of the sheath is developed. The sheath is made of one or several regions of uniform plasma density. A consistent set of boundary conditions is developed from hydrodynamic theory. The absorptive boundary condition is used at the conductor-plasma interface. This model is applied to the spherical probe in order to calculate its admittance. At low frequency, the probe displays a non-zero conductance that agrees with the predictions of kinetic theory. The model is also applied to an infinite conducting cylinder in order to study surface waves. The sheath-wave dispersion is found to be very sensitive to the sheath-density profile. These results invalidate the use of a vacuum sheath except for very low frequency and high negative bias. A new class of waves, named presheath wave, is found also to propagate along the wire. Experimentally, the sheath wave mode is studied and found to be very well described by this new sheath model. Presheath waves are also observed and found consistent with the theoretical predictions.

10421 **Ion Bernstein modes in current-carrying plasmas.** Milovich, J.L. Los Angeles, CA; Univ. of California (1987). 343p. University Microfilms Order No. 88-00,612.

Thesis (Ph. D.).

Two aspects of ion Bernstein wave (IBW) propagation in current-carrying plasmas are studied. The first is the inclusion of an electron tail in addition to the Maxwellian background. The second is the modifications introduced by a shearless poloidal magnetic field. The former is studied in the electrostatic and electromagnetic cases. The tail gives rise to an increase in the electron Landau damping. The tail also causes a change in the sign of the electron susceptibility at certain parallel phase velocities of the wave. As a result, a normally evanescent model is now allowed to propagate and couple to the already existing IBW (in the electrostatic case), and both the IBW and fast wave (in the electromagnetic case). The presence of a poloidal field is studied by a considering a bounded homogeneous cylindrical plasma in the electrostatic limit. An integro-differential equation for the potential is obtained from the linearized Vlasov-Poisson set of equations. It was found that, for finite poloidal wave number, the radial dependence of the component of k perpendicular to the local B-field, gives rise to an effective centrifugal barrier which may prevent waves coming from the plasma edge to reach the center.

**10422 Linear optimal control of plasma position, shape, and current in a tokamak fusion reactor.** Kessel, C.E. Jr. Los Angeles, CA; Univ. of California (1987). 224p. University Microfilms Order No. 88-00,609.

Thesis (Ph. D.).

The control of plasma position, shape, and current in a tokamak fusion reactor is examined using linear optimal control. These advanced tokamaks are characterized by non up-down symmetric coil and structure, thick structure surrounding the plasma, eddy current, shaped plasmas, superconducting magnets, instability arising from the plasma vertical motion, and hybrid function coils providing ohmic heating, vertical field, radial field, and shaping field. Physical models of the electromagnetic environment in a tokamak are derived and used to construct control gains that are tested in nonlinear simulations with initial perturbations. The issues of applying linear optimal control to advanced tokamaks are addressed, including generating a nominal trajectory, dealing with the ill-conditioning of the system, complex equilibrium control, choice of the cost functional weights, discrete control, and order reduction. Results indicate that linear optimal control is a feasible technique for controlling advanced tokamaks where the more common classical control will be severely strained.

**10423 Calculation of the line shapes of radiators immersed in plasma.** Hayrapetian, A.S. Irvine, CA; Univ. of California (1987). 140p. University Microfilms Order No. 88-01,935.

Thesis (Ph. D.).

This work reports the results of theoretical calculations of line shapes of radiators immersed in plasma. The fluctuating electric field of the plasma perturbs the atomic structure of the immersed ions or atoms. The perturbed line shape is an important diagnostic tool for the temperature and density measurements of plasma. The line-shape calculation here is done by first deriving the line-shape expression, then it is shown that the problem is equivalent to calculating the temperature Green's function of the bound electron. The total Hamiltonian of the system includes the atomic, plasma, and atom-plasma parts. The temperature Green's function is calculated perturbatively by expanding in orders of atom-plasma interaction. By solving a Dyson equation, the dressed Green's functions of the bound electrons are obtained. At this point, the line shape is calculated by an analytic continuation from the complex frequency plane to real line. To derive the atomic electron Green's function, the momentum integral in the self-energy is approximated by a Riemann sum. With this approximation, the algebraic form of the line shape is obtained for an undetermined number of terms in the Riemann sum. Numerical calculation of line shape is done by using this result.

**10424 Superthermal electron-distribution measurements with electron-cyclotron emission.** Luce, T.C. Princeton, NY; Princeton Univ. (1987). 125p. University Microfilms Order No. 88-00,417.

Thesis (Ph. D.).

Electron-cyclotron emission was used during lower-hybrid current-drive experiments on the PLT tokamak to determine the velocity distribution of the superthermal electrons. Both polarizations of the second and third harmonic emission in the frequency range 110-170 GHz were measured with a swept heterodyne radiometer. The plasma was found to be optically thin to this radiation, and a viewing dump inside the vacuum vessel was needed to eliminate spurious radiation from wall reflections. Analysis techniques used to interpret previous experiments were not adequate to describe the measured emission spectra. Therefore, a simple inversion developed gives a significant increase in the velocity space information available compared to a fitting function. The results given by the inversion are shown to be consistent with previous experiments. The inversion shows clearly the effects of moving the runaway boundary in velocity space. The data were compared to an asymptotic and a numerical solution to the Fokker-Planck equation for lower-hybrid current drive.

**10425 QN3D: a three-dimensional quasi-neutral hybrid particle-in-cell code with applications to the tilt-mode instability in field-reversed configurations.** Horowitz, E.J. Davis, CA; Univ. of California (1987). 138p. University Microfilms Order No. 87-29,949.

Thesis (Ph. D.).

The tilt-mode instability of a field-reversed configurations (FRC) is discussed. Current numerical models do not properly explain the behavior of this mode. A particle-in-cell (PIC) model in cartesian coordinates is introduced with an explanation as to why it represents the physics of FRCs more closely. The model is presented by first simplifying Maxwell's equations using the Darwin limit. A final set of equations are derived by assuming the electrons to be an inertialess fluid with zero temperature. The PIC model is implemented in a FORTRAN code, QN3D. The major elements of this code are presented, indicating the many techniques required for its optimization. Many of the major factors in optimization are dependent upon features of the Cray-2 Multiprocessor. Taking advantage of these new features is discussed in the text.

**10426 Waves and instabilities in an electron-positron plasma in an ultra-strong magnetic field.** Pulsifer, P.E. Chestnut Hill, MA; Boston College (1987). 403p. University Microfilms Order No. 88-01,071.

Thesis (Ph. D.).

Magnetic fields of up to $10^{13}$ gauss have been observed in pulsars. At these ultrastrong fields, the energy between Landau levels is comparable to the electron rest-mass, and the cyclotron radius is comparable to Compton wavelength. To study the electromagnetic properties of an electron or positron gas in such ultrastrong fields, the polarization tensor II/sub μnu/ is calculated. This response function is simply related to other functions like the dielectric and diamagnetic tensors. A dispersion relation is found involving II/sub μnu/, whose solution determines the frequency-wavenumber relation for propagating electromagnetic waves in the system. Damping of these waves is determined by the imaginary part of II/μnu/. A relativistic quantum-kinetic (Wigner function) technique is used. A relativistic treatment is needed partly because of the high magnetic field and partly because of the assumed high electron densities (of order $10^{29}$ $cm^{-3}$). The quantum analog to the Vlasov equation is derived and linearized about a zero-temperature Fermi equilibrium, an approximation scheme equivalent to the random-phase-approximation (RPA). An integral equation is found for the four-current, which then determines the polarization tensor.

## 7002 Fusion Power Plant Technology

*REFER ALSO TO CITATION(S) 8145, 8146, 8147, 8149, 8150, 8152, 8383, 8924, 8925, 9824, 10353, 10358, 10404, 10407, 10415, 10422*

**10427 (AD-A—199537/2/XAB) X-ray spectroscopy of laser-produced l-series lines. Interim report.** Burkhalter, P.G.; Newman, D.A. (Naval Research Lab., Washington, DC (USA)). 31 Aug 1988. 29p. (NRL-MR—6286). NTIS, PC A03/MF A01.

High intensity, frequency-tripled, focused light from a multibeam laser system (OMEGA) was utilized to generate plasma of highly-ionized atoms. This work involves the accurate wavelength measurements of 2p-3d,3s,4d,4s lines in L-series spectra of transition elements. The data were collected with high-resolution x-ray spectrographs. The observed lines were classified based on ab initio, atomic structure calculations using adjusted Slater parameters. The spectral results are presented as isoelectronic sequences of the observed and calculated wavelengths for the Li-, Be-, and B-like stages of ionization from atomic numbers 22 (Ti) through 32 (Ge).

**10428 (ANL/FPP/TM—226) Argonne National Laboratory contributions to the International Symposium on Fusion Nuclear Technology (ISFNT).** (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 286p. (CONF-880417—). NTIS, PC A13/MF A01 - OSTI. Order Number DE89004615/JAW.

From 1. international symposium on fusion nuclear technology (ISFNT); Tokyo, Japan (10 Apr 1988).

A total of sixteen papers with authors from Argonne National Laboratory were presented at the First International Symposium on Fusion Nuclear Technology (ISFNT), held in Tokyo, Japan, in April 1988. The papers cover the results of recent investigations in blanket design and analysis, fusion neutronics, materials experiments in liquid metal corrosion and solid breeders, tritium recovery analy-

sis, experiments and analysis for liquid metal MHD, reactor safety and economic analysis, and transient electromagnetic analysis.

10429 **(CNIC—00150) Numerical simulation and theoretical analysis of laser-fusion exploding pusher target experiment.** Zhang Jun; Huang Shuke; Zeng Xiancai; Jiang Ronghong; Chen Fuzhi; Zhang Tanxin; Gao Fei. (Inst. of Applied Physics and Computational Mathematics., Beijing, BJ (China)). (China Nuclear Information Centre, Beijing, BJ). Feb 1988. 10p. (In Chinese). (IAPCM—0007). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705059/JAW.

One and two dimensional hydrodynamic numerical simulations of exploding pusher targets as well as the numerical simulation of characteristic lines emitted by Ne contained in the target have been studied. The results show that the two dimensional effects are considerable in the imploding processes of the exploding pusher targets with two beams of laser light. The numerical results of physical quantities are in various degrees consistent with the experimentally obtained ones. The results obtained by the theoretical analytical formulae are quantitatively in agreement with the experimental ones.

10430 **(CNIC—00159) Coupling physics of laser-planar targets and related laws.** Zhang Jun; Chang Tieqing; Chen Guangnan; Xu Shaoze; Sui Chengzhi; You Xiwen; Gu Peijun; Yang Huaye. (Inst. of Applied Physics and Computational Mathematics., Beijing, BJ (China)). (China Nuclear Information Centre, Beijing, BJ). Feb 1988. 9p. (In Chinese). (IAPCM—0008). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705064/JAW.

The coupling physics of laser-targets is important for laser fusion. Laser produced X-ray has wide application in laboratory. In some cases high energy fraction of the X-ray produced by laser is a main requirement for target design. Therefore, theoretically clearing up the coupling physics of the laser-targets coupling can provide some substantial information for the target design and experimental research of ICF. The theoretical study of the laser-targets coupling physics includes the absorption of laser, atomic dynamics of bound and free electrons and ion temperatures, etc.. This paper investigates the problem with 'LTX-1' code made by the authors. The authors analysed the physical proceses and emission mechanism of the laser produced X-ray and give the related scaling laws. The obtained numerical results are substantially consistent with the ones which have been published. In addition, some analytial results are also presented and compared with the numerical ones.

10431 **(CONF-871007—71) The configuration development of the compact ignition tokamak device.** Brown, T.G. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88015229/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Compact Ignition Tokamak (CIT) device is planned as the next major fusion device to be built at the Princeton Plasma Physics Laboratory to demonstrate ignition operations of a burning plasma. Stringent engineering requirements have been imposed on this device by physics necessities of high margins against ignition and by cost constraints in minimizing the overall cost of the project. A compact design has been developed under these design conditions incorporating many unique design features, including a hydraulic preload system to provide a compression load to the toroidal field (TF) inner leg and using a high-strength copper-Inconel composite material in the design of the TF coil and the ohmic heating solenoid. The device is inertially cooled by liquid nitrogen, and the vacuum vessel, coils, and supporting structure are contained in a thermally insulated cryostat. A close-in igloo shield surrounds the device to provide the capability for hands-on access within the test cell and also to minimize activation. Even with the compact nature of this device, there still remains the basic requirement of maximizing access to the plasma for diagnostics and heating components; access for electrical leads and coolant lines; and access to provide the capability of remotely maintaining all diagnostic and peripheral equipment that interfaces with the device. This paper describes the configurational development that has taken place during the conceptual design period of the CIT project, highlighting the major design integration features used to develop a functional device that meets the physics and component design requirements. 1 ref., 7 figs.

10432 **(CONF-880613—24) Precipitation sensitivity to alloy composition in Fe-Cr-Mn austenitic steels developed for reduced activation for fusion application.** Maziasz, P.J.; Klueh, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003367/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, United States (27 Jun 1988).

Special austenitic steels are being designed in which alloying elements like Mo, Nb, and Ni are replaced with Mn, W, V, Ti, and/or Ta to reduce the long-term radioactivity induced by fusion reactor irradiation. However, the new steels still need to have properties otherwise similar to commercial steels like type 316. Precipitation strongly affects strength and radiation-resistance in austenitic steels during irradiation at 400–600{degree}C, and precipitation is also usually quite sensitive to alloy composition. The initial stage of development was to define a base Fe-Cr-Mn-C composition that formed stable austenite after annealing and cold-working, and resisted recovery or excessive formation of coarse carbide and intermetallic phases during elevated temperature annealing. These studies produced a Fe-12Cr-20Mn-0.25C base alloy. The next stage was to add the minor alloying elements W, Ti, V, P, and B for more strength and radiation-resistance. One of the goals was to produce fine MC precipitation behavior similar to the Ti-modified Fe-Cr-Ni prime candidate alloy (PCA). Additions of Ti+V+P+B produced fine MC precipitation along network dislocations and recovery/recrystallization resistance in 20% cold worked material aged at 800{degree}C for 166h, whereas W, Ti, W+Ti, or Ti+P+B additions did not. Addition of W+Ti+V+P+B also produced fine MC, but caused some $\sigma$ phase formation and more recrystallization as well. 29 refs., 14 figs., 9 tabs.

10433 **(CONF-880613—26) Void formation and helium effects in 9Cr-1MoVNb and 12Cr-1MoVW steels irradiated in HFIR and FFTF at 400{degree}C.** Maziasz, P.J.; Klueh, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89004798/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, United States (27 Jun 1988).

Martensitic/ferritic 9Cr-1MoVNb and 12Cr-1MoVW steels doped with up to 2 wt% Ni have up to 450 appm He after HFIR irradiation to {approximately}38 dpa, but only 5 appm He after 47 dpa in FFTF. No fine He bubbles and few or no larger voids were observable in any of these steels after FFTF irradiation at 407{degree}C. By contrast, many voids were found in the undoped steels (30-90 appm He) irradiated in HFIR at 400{degree}C, while voids plus many more fine He bubbles were found in the Ni-doped steels (400-450 appm He). Irradiation in both reactors at {approximately}400{degree}C produced significant changes in the as-tempered lath/subgrain boundary, dislocation, and precipitation structures that were sensitive to alloy composition, including doping with Ni. However, for each specific alloy the irradiation-produced changes were exactly the same comparing samples irradiated in FFTF and HFIR, particularly the Ni-doped steels. Therefore, the increased void formation appears solely due to the increased helium generation found in HFIR. While the levels of void swelling are relatively low after 37-39 dpa in HFIR (0.1-0.4%), details of the microstructural evolution suggest that void nucleation is still progressing, and swelling could increase with dose. The effect of helium on void swelling remains a valid concern for fusion application that requires higher dose experiments. 15 refs., 14 figs., 8 tabs.

10434 **(CONF-881031—2) Resonant double loop antenna development at ORNL.** Taylor, D.J.; Baity, F.W.; Brown, R.A.; Bryan, W.E.; Fadnek, A.; Hoffman, D.J.; King, J.F.; Livesey, R.L.; McIlwain, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88017368/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

As part of the development of ion cyclotron resonant heating (ICRH) systems for fusion research, Oak Ridge National Laboratory (ORNL) has built resonant double loop (RDL) antennas for the Tokamak Fusion Test Reactor (TFTR) (Princeton Plasma Physics Laboratory, Princeton, NJ, US) and Tore Supra (Centre d'Etudes Nucleaire, Cadarache, France). Each antenna has been designed to deliver 4 MW of power. The electrical circuit and the mechanical philosophy employed are the same for both antennas, but different operating environments lead to substantial differences in the designs of specific components. A description and a comparison of the technologies developed in the two designs are presented. 5 refs., 4 figs., 1 tab.

10435 **(CONF-881031—36) Lithium-lead/water reaction experiments and analysis.** Herzog, J.P.; Corradini, M.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003648/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

An experiment has been performed to investigate the chemical reaction between the liquid phases of the eutectic lithium-lead ($Li_{17}Pb_{83}$) and water. The reactants and products were constrained within a closed reaction vessel, allowing the extent of reaction to be determined from the partial pressure of the hydrogen reaction product. The data from the tests showed that the extent of reaction did not depend upon the water temperature. The data also indicated that the extent of reaction passed through a maximum as the initial liquid metal temperature was varied from 350 to 500 C, and a model was developed to explain this behavior. 11 refs., 3 figs.

10436 **(CONF-881031—48) The design of a heat transfer liquid metal MHD experiment for ALEX [Argonne Liquid-Metal Experiment].** Picologlou, B.F.; Reed, C.B.; Hua, T.Q.; Lavine, A.S. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004270/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

An experiment to study heat transfer in liquid metal MHD flow, under conditions relevant to coolant channels for tokamak first wall and high heat flux devices, is described. The experimental configuration is a rectangular duct in a transverse magnetic field, heated on one wall parallel to the field. The specific objective of the experiment is to resolve important issues related to the presence and heat transfer characteristics of wall jets and flow instabilities in MHD flows in rectangular duct with electrically conducting walls. Available analytical tools for MHD thermal hydraulics have been used in the design of the test article and its instrumentation. Proposed tests will cover a wide range of Peclet and Hartmann numbers and interaction parameters. 14 refs., 3 figs., 1 tab.

10437 **(CONF-881031—49) Sidewall flow instabilities in liquid metal MHD flow under blanket relevant conditions.** Reed, C.B.; Picologlou, B.F. (Argonne National Lab., IL (USA)). 7 Oct 1988. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004277/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

A flow instability has been observed in a rectangular thin conducting wall duct in MHD experiments at ANL's ALEX facility. It developed in a side layer jet attached to a side wall parallel to the applied B-field. The nature of the instability resembles very strongly that of a classic laminar instability in ordinary fluid mechanics. The phenomenon is distinguished from ordinary turbulence by its strong periodicity and its lack of small scale structure. A preliminary identification of the factors which may influence the instability has been made. For the conditions and test section geometry reported here, the instability appears at an approximately constant critical Reynolds number 2650 < Re/sub cr/ < 5100, independent of Hartmann number in the range 2700 < M < 5400. 6 refs., 18 figs.

10438 **(CONF-8805231—1) Numerical solutions of three-dimensional MHD flows in strong non-uniform transverse magnetic fields.** Hua, T.Q.; Walker, J.S. (Argonne National Lab., IL (USA)). Jul 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003645/JAW.

From IUTAM symposium on liquid metal MHD; Riga, USSR (16 May 1988).

Magnetohydrodynamic flows of liquid metals in thin conducting ducts of various geometries in the presence of strong non-uniform transverse magnetic fields are examined. The interaction parameter and Hartmann number are assumed to be large, whereas the magnetic Reynolds number is assumed to be small. Under these assumptions, viscous and inertial effects are confined in very thin boundary layers adjacent to the walls. At walls parallel to the magnetic field lines, as at the side walls of a rectangular duct, the boundary layers (side layers) carry a significant fraction of the volumetric flow rate in the form of high velocity jets. This paper describes the analysis and summarizes the numerical methods for obtaining 3-D solutions (core solutions) for flow parameters outside these layers, without solving explicitly for the layers themselves. 13 refs., 1 fig.

10439 **(CONF-8805231—2) Experimental investigation of 3-D MHD flows at high Hartmann number and interaction parameters.** Picologlou, B.F.; Reed, C.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003643/JAW.

From IUTAM symposium on liquid metal MHD; Riga, USSR (16 May 1988).

Experimental investigations of 3-D MHD flows in uniform thin conducting wall ducts of circular and square cross section, conducted at Argonne National Laboratory's ALEX facility, are reported. The three-dimensional nature of the flow arises from the spacial variation of the applied transverse magnetic field. Measurements were performed at several Hartmann numbers, M, and interaction parameters, N, with the peak value for M exceeding 6 {times} $10^3$ and the peak value for N exceeding $10^5$. Typical results and their comparison to numerical analysis reported in a companion paper are given, as is a brief description of the ALEX facility and the experimental methods employed. Ongoing activities and plans for future experiments are also discussed. 6 refs., 3 figs.

10440 **(CONF-8810231—1) The ORNL/Tore Supra pellet injector the E-beam rocket pellet accelerator.** Foster, C.A.; Tsai, C.C.; Schechter, D.E.; Gouge, M.J.; Milora, S.L.; Combs, S.K.; Gethers, F.E.; Simmons, D.W.; Sohns, C.W.; Argo, B.E.; Barber, G.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89003126/JAW.

From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising, F.R. Germany (24 Oct 1988).

This paper discusses the centrifuge injector for Tora Supa and the electron beam rocket acceleration of a solid deuterium-tritium fuel pellet in Tora Supa. 5 refs., 1 figs

10441 **(CONF-8810231—5) Pneumatic pellet injector research at ORNL.** Milora, S.L.; Combs, S.K.; Foster, C.A.; Schuresko, D.D.; Gouge, M.J.; Fisher, P.W.; Argo, B.E.; Barber, G.C.; Fehling, D.T.; Foust, C.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004915/JAW.

From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising, F.R. Germany (24 Oct 1988).

Advanced pneumatic-injector-based pellet fueling systems are under development at Oak Ridge National Laboratory (ORNL) for fueling magnetically confined plasmas. The general approach is that of producing and accelerating frozen hydrogen isotope pellets at speeds in the range from 1 to 2 km/s and higher. Recently, ORNL provided pneumatic-based pellet fueling systems for the Tokamak Fusion Test Reactor (TFTR) and the Joint European Torus (JET), and a new simplified eight-shot injector has been developed for use on the Princeton Beta Experiment (PBX) and the Advanced

Toroidal Facility (ATF). These long-pulse devices operate reliably at up to 1.5 km/s with pellet sizes ranging between 1 and 6 mm. In addition to these activities, ORNL is pursuing advanced technologies such as the electrothermal gun and the two-stage light-gas gun to achieve pellet velocities significantly in excess of 2 km/s and is carrying out a tritium proof-of-principle (TPOP) experiment in which the fabrication and acceleration of tritium pellets to 1.4 km/s were recently demonstrated. 27 refs., 10 figs.

10442 (DOE/ER—0313/4, pp 2-6) **Design and fabrication of HFIR-MFE RB* spectrally tailored irradiation capsules.** Longest, A.W.; Corum, J.E.; Heatherly, D.W. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Design and fabrication of four High Flux Isotope Reactor-magnetic fusion energy removable beryllium capsules (60, 200, 330, and 400{C) to accommodate magnetic fusion energy specimens preirradiated in spectrally tailored experiments in the ORR are proceeding satisfactorily. These capsule designs incorporate provisions for removal, examination, and re-encapsulation of the MFE specimens at intermediate exposure levels en route to a target exposure level of 30 displacements per atom (dpa). With the exception of the 60°C capsule, where the test specimens will be in direct contact with the reactor cooling water, the specimen temperatures (monitored by 21 thermocouples) will be controlled by varying the thermal conductance of a small gap region between the specimen holder and the containment tube. Hafnium sleeves will be used to tailor the neutron spectrum to closely match the helium production-to-atom displacement ratio (14 appm/dpa) expected in a fusion reactor first wall. Design and preparation of fabrication drawing for the 60 and 330°C capsules and all generic capsule components and support facilities have now been completed. Assembly of the 60°C capsule is complete and the 330°C capsule is nearing completion. The irradiation of both capsules will begin when the HFIR returns to full power operation. Design and preparation of fabrication drawings for the 200 and 400°C capsules will be completed in 1988, and operation of these two capsules will follow the first two (60 and 330°C). 5 references, 3 figures, 1 table.

10443 (DOE/ER—0313/4, pp 7-9) **Status of US-Japan collaborative program phase II HFIR target capsules.** Senn, R.L. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this program is to determine the response of various US and Japanese austenitic stainless steels with different pretreatments and alloy compositions to the combined effects of displacement damage and helium generation at temperatures in the range of 300 to 600°C. The experiment matrix for Phase II HFIR target capsules (JP-9 through JP-16) was further revised to resolve certain discrepancies regarding specimen volume and position details. A thermal analysis to account for these changes was completed and the required new parts are on order. All eight capsules will be assembled and installed in the HFIR simultaneously beginning with the first full power operating cycle. 1 figure, 2 tables.

10444 (DOE/ER—0313/4, pp 12-21) **Reduced activation calculations at Hanford.** Mann, F.M. (Westinghouse Hanford Company, Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Material activation is an inherent property of d-T fusion devices. Materials can be chosen, therefore, not only for their structural properties under irradiation but also for their favorable activation characteristics. Calculations of the long-term activation for various materials under ITER-like conditions show that the reduced activation materials being pursued would meet NRC Class C regulations for near surface disposal. Limits for each of the materials studied are determined by the presence of Mo and Nb (whether as a minor constituent or as impurities). Plans for improving the cross section and decay data libraries involve the creation of a joint Dutch-UK-US activation cross section library and in using the ENDF/B-VI libraries. 1 reference, 6 figures, 6 tables.

10445 (DOE/ER—0313/4, pp 22-24) **Radiation damage calculations for compound materials.** Greenwood, L.R. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The SPECOMP computer code has been used to calculate neutron-induced displacement damage cross sections for compound materials, such as alloys, insulators, and ceramic tritium breeders for fusion reactors. These new calculations rely on recoil atom energy distributions which are stored in our SPECTER computer code master libraries. Calculations have been completed for stainless steel, vanadium alloys, $^6$Li-compound tritium breeders, alumina, $SiO_2$, $Cu_3Au$, TaO, and NbTi superconductors. Cross sections are now being developed for other compounds; however, some research is needed to determine the proper threshold energies for many compounds. 3 references, 1 table.

10446 (DOE/ER—0313/4, pp 25-27) **Dosimetry and damage analysis for the Omega West Reactor.** Greenwood, L.R. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Neutron dosimetry measurements and damage calculations were completed for three experiments in the Omega West Reactor (LANL). These irradiations were conducted by Hanford Engineering Development Laboratory and were designed to compare radiation damage produced in a fission reactor spectrum with damage produced by 14 MeV neutrons at RTNS II. Small dosimetry capsules were included with each experiment. Each capsule contained wires of 0.1% Co-Al, Ni, Fe, Ti, and 80% Mn-Cu. Each wire was gamma counted at Argonne and activation rates were computed considering the irradiation histories and gamma absorption. Neutron energy spectral adjustments were then made for each irradiation using the STAY'SL computer code starting with a previously-measured spectrum. The resultant fluxes and fluences are given. Damage calculations were performed for each run using the SPECTER computer code. 4 references, 4 tables.

10447 (DOE/ER—0313/4, pp 30) **Materials handbook for fusion energy systems.** Davis, J.W. (McDonnell Douglas Astronautics Company, St. Louis, MO (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this work is to provide a consistent and authoritative source of material property data for use by the fusion community in concept evaluation, design, and performance/verification studies of the various fusion energy systems. A second objective is the early identification of areas in the materials data base where insufficient information or voids exist. The effort during this reporting period has focused on two areas: (1) publication of data pages, and (2) automation of the data pages. The data pages contained new engineering information on lithium and stainless steel along with additional Supporting Documentation pages on annealed and cold worked stainless steel. These pages were distributed in May. In the area of automation, work is proceeding on schedule toward the formation of an electronic materials data base for the MFE computer network.

10448 (DOE/ER—0313/4, pp 34-60) **Irradiation creep mechanism: an experimental perspective.** Garner, F.A.; Gelles, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The object of this effort is to determine the mechanisms involved in radiation-induced deformation of structural materials and

to apply these insights for extrapolation of available fast reactor data to fusion-relevant conditions. An extensive review was conducted of a variety of radiation-induced microstructural data, searching for microstructural records of various irradiation creep mechanisms. It was found that the stress-affected evolution of dislocation microstructure during irradiation is considerably more complex than envisioned in most theoretical modeling studies, particularly in the types of interactive feedback mechanisms operating. Reasonably conclusive evidence was found for a SIPA-type mechanism (stress-induced preferential absorption) operating on both Frank loops and network dislocations. Stress-induced preferential loop nucleation (SIPN) processes may also participate but are thought to be overshadowed by the stronger action of the SIPA-type processes operating on Frank interstitial loops. It was not possible to discern from microstructural evidence between second-order SIPA and first-order SIPA mechanisms, the latter arising from anisotropic diffusion. Evidence was presented, however, that validates the operation of stress-induced preferential unfaulting of Frank loops and stress-induced growth of previously stressed material following removal of applied stress. Dislocation glide mechanisms are also participating but the rate appears to be controlled by SIPA-type climb processes. Applied stresses were shown to generate very anisotropic distributions of Burgers vector in the irradiation-induced microstructure. 108 references, 15 figures, 1 table.

10449 (DOE/ER—0313/4, pp 61-71) **Detailed derivation of stochastic theory of diffusional planar atomic clustering.** Ghoniem, N.M. (Univ. of California, Los Angeles (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Atomic clustering into circular planar disks is an important process responsible for interstitial loop formation in the bulk of irradiated materials, and the evolution of atomic planes during thin film growth. In this report, the authors develop a general stochastic theory for the formation of planar atomic clusters by atomic diffusion. Equations for the rates of change of atomic species, and for the nucleation rate of atomic clusters are simultaneously solved with appropriate equations for the average size and various moments of the distribution function. An application of the theory is given by comparing the results of calculations with experimental data on interstitial loop formation in ion-irradiated nickel. 46 references, 9 figures, 2 tables.

10450 (DOE/ER—0313/4, pp 72-75) **Influence of nickel content on the swelling of Fe-Cr-Mn-Ni alloys.** Garner, F.A.; Takahashi, H. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The density changes measured in three separate series of Fe-Cr-Mn-Ni austenitic alloys irradiated in Fast Flux Text Facility - Materials Open Test Assembly Cycle 1D indicates that nickel additions do not decrease swelling as had been anticipated. These data are contrary to the behavior observed in electron irradiation of one of these three alloy series. 6 references, 3 figures, 2 tables.

10451 (DOE/ER—0313/4, pp 78-88) **Effects of irradiation on low activation ferritic alloys.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

A broad range of ferritic alloys is possible which satisfy the low activation requirement for near-surface burial of fusion reactor materials after decommissioning. Low activation bainitic alloys in the Fe-2Cr composition range, martensitic alloys in the Fe-7 to 9Cr range and stabilized martensitic alloys in the Fe-12Cr range have been successfully fabricated and are undergoing testing as demonstrated by efforts in Europe, Japan and the United States. However, it is found that irradiation significantly degrades the properties of bainitic and stabilized martensitic alloys. Bainitic alloys containing vanadium develop severe hardening due to irradiation-induced precipitation at temperatures below 450°C and extreme softening due to carbide coarsening at temperatures above 500°C. Stabilized martensitic alloys which rely on manganese additions to provide a fully martensitic microstructure are embrittled at grain boundaries following irradiation leading to severe degradation of impact properties. The most promising composition regime appears to be the Fe-7 to 9 Cr range with tungsten additions in the 2% range where high temperature mechanical properties and microstructural stability are retained and impact properties are relatively unaffected by irradiation. 25 references, 9 figures, 3 tables.

10452 (DOE/ER—0313/4, pp 89-94) **Development of ferritic steels for fast induced-radioactivity decay.** Klueh, R.L.; Alexander, D.J.; Corwin, W.R. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Induced radioactivity in the first-wall and blanket-structure materials will make these components highly radioactive after their service lifetime, leading to difficult radioactive waste-management problems. One way to minimize the disposal problem is to use structural materials in which radioactive isotopes induced by irradiation decay quickly to levels that allow simplified disposal techniques. The authors are assessing the feasibility of developing such ferritic steels. Charpy impact tests were made on eight heats of normalized-and-tempered chromium-tungsten steel that contained various levels of chromium, tungsten, vanadium, and tantalum. The impact behavior of several of these steels was found to compare favorably with the properties of analogous chromium-molybdenum steels that are presently being considered as candidate structural materials for fusion-reactor applications. 17 references, 3 figures, 2 tables.

10453 (DOE/ER—0313/4, pp 95-107) **Fractographic examination of low activation ferritic alloy Charpy impact specimens.** Gelles, D.S.; Cannon, N.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this work is to determine the applicability of low activation ferritic alloys as fusion reactor structural materials. Miniature charpy specimens of six low activation ferritic alloys have been fractographically examined in order determine the effect of irradiation on impact fracture behavior. A change in brittle fracture mode due to irradiation was found for four of the six alloys. The fracture mode changed from transgranular cleavage to intergranular failure at prior austenite boundaries. The cause is ascribed to Mn additions in the alloys. Examinations also indicated that for the 9Cr-1W alloy, the ductile to brittle transition temperature as measured by absorbed energy measurements does not agree with an explanation based on fracture appearance. The cause is not yet understood. 8 references, 17 figures, 1 table.

10454 (DOE/ER—0313/4, pp 108-112) **Impact behavior of 9-Cr and 12-Cr ferritic steels after low-temperature irradiation.** Klueh, R.L.; Vitek, J.M.; Corwin, W.R.; Alexander, D.J. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Miniature Charpy impact specimens of 9Cr-1MoVNb and 12Cr-1MoVM steels and these steels with 1 and 2% of Ni were irradiated in the High-Flux Isotope Reactor (HFIR) at 50°C to displacement damage levels of up to 9 dpa. Nickel was added to study the effect of transmutation helium. Irradiation caused an increase in the ductile-brittle transition temperature (DBTT). The 9Cr-1MoVNb steels, with and without nickel, showed a larger shift than the 12Cr-1MoVM steels, with and without nickel. Under certain conditions, the DBTT of the nickel-doped steels showed a larger shifts than that of the undoped steels. The results were interpreted to mean that helium affected the DBTT in the same way as the displacement damage. 16 references, 1 figure, 1 table.

10455 (DOE/ER—0313/4, pp 113-121) **Fractographic examination of Charpy impact specimens from the HFIR-MFE-RB2 test.** Gelles, D.S.; Hu, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this work is to determine the effect of low temperature irradiation in HFIR on the properties of ferritic stainless steels in order to determine the applicability of these alloys as first wall materials. Selected fracture surfaces of miniature Charpy specimens of HT-9 in base metal, weld metal and heat affected zone (HAZ) metal conditions, and 9Cr-1Mo in base metal and weld metal conditions have been examined by scanning electron microscopy following irradiation in High Flux Isotope Reactor-Magnetic Fusion Energy-RB2 at 55°C to 10 dpa. Hardness measurements have also been made. Comparison of results with results on specimens irradiated to low dose demonstrates only minor changes in fracture behavior, but continued increases in hardness due to irradiation. Therefore, the mechanism controlling the degradation of impact properties does not affect the fracture path but does affect strength. A mechanism is proposed to explain the behavior based on microchemical segregation of carbide forming elements. 5 references, 10 figures, 1 table.

10456 (DOE/ER—0313/4, pp 122-129) **Microstructural development of 10Cr-2Mo ferritic steel irradiated in HFIR at 500C to 34 dpa.** Suzuki, M.; Maziasz, P.J.; Hamada, S.; Hishinuma, A. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Microstructural development was studied in 10Cr-2Mo ferritic steel containing 1 wt % Ni which as irradiated to 34 dpa at 500°C in High Flux Isotope Reactor. The results showed considerable evolution of the precipitates, but no significant void development was observed. The $\sigma$- and Chi-phases were identified as radiation-induced precipitates in this steel. 10 figures, 1 table.

10457 (DOE/ER—0313/4, pp 130-134) **Irradiation creep in type 316 stainless steel and U.** Grossbeck, M.L.; Horak, J.A. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Irradiation creep was investigated in type 316 stainless steel (316 SS) and US Fusion Program PCA using a tailored spectrum of the Oak Ridge Research Reactor (ORR), in order to achieve a He:dpa value characteristic of a fusion reactor first wall. Pressurized tubes with stresses of 20 to 470 MPa were irradiated at temperatures of 330, 400, 500 and 600°C. It was found that irradiation creep was independent of temperature in this range and varied linearly with stress at low stresses, but the stress exponent increased to 1.3 and 1.8 for 316 SS and PCA, respectively, at higher stresses. Specimens of PCA irradiated in the ORR and having helium levels up to 200 appm experienced a 3 to 10 times higher creep rate than similar specimens irradiated in the Fast Flux Test Facility (FFTF) and having helium levels below 20 appm. The higher creep rates are attributed to either a lower flux of the presence of helium. A mechanism involving interstitial helium-enhanced climb is proposed. The enhanced creep rates observed in the presence of helium might serve to relieve swelling stresses in a fusion reactor first wall, and hence, must be considered in reactor design. 17 references, 5 figures, 1 table.

10458 (DOE/ER—0313/4, pp 135-145) **Irradiation creep and embrittlement behavior of AISI 316 stainless steel at very high neutron fluences.** Porter, D.L.; Garner, F.A. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The irradiation-induced creep and swelling of AISI 316 stainless steel have been investigated at two temperatures (400 and 550°C) to very high neutron fluences. It is shown that creep and swelling can be considered as interactive phenomena with several stages of creep related to the total amount of accumulated swelling. The final stage involves the apparent cessation of creep and has been observed only at the higher irradiation temperature. The development of a coincident and severe ex-reactor embrittlement problem after irradiation at 400°C appears also to be separately related to the development of substantial swelling. This latter phenomenon was not observed at 550°C. The mechanisms thought to be possible responsible for each of these two phenomena are discussed in detail. 30 references, 9 figures.

10459 (DOE/ER—0313/4, pp 146-159) **Swelling and phase stability of commercial Fe-Cr-Mn alloys irradiated in FFTF-MOTA.** McCarthy, J.M.; Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Five commercial alloys based on the Fe-Cr-Mn alloy system have been irradiated in Fast Flux Test Facility-Material Open Test Assembly at 420, 520 and 600°C to exposures ranging as high as 60 to 75 dpa. Some alloys were irradiated in two or three thermal-mechanical starting conditions. Density measurements have been performed on all combinations of alloy, thermal-mechanical treatment and irradiation condition. Microscopy on three of the five alloys has been completed, concentrating only on the highest exposure level at each temperature. Compared to the simple Fe-Cr-Mn ternary alloys, the commercial alloys tended to develop less $\alpha$- and epsilon-martensite and $\alpha$-ferrite but higher levels of $M_{23}C_6$ and $\sigma$. 15 references, 23 figures, 2 tables.

10460 (DOE/ER—0313/4, pp 160-167) **Hydrogen concentration distribution in vanadium-base alloys after surface preparation and exposure to liquid lithium.** Loomis, B.A.; Hull, A.B.; Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this research is to provide guidance on the applicability of vanadium-base alloys for structural components in a fusion reactor. The H concentration distributions in near-surface layers of V-15Cr-5-Ti and V-3Ti-0.5Si alloy specimens were determined by use of a chemical dissolution technique together with a determination of the hydrogen partial pressure on heating the specimens. These results contribute to an understanding for the exceptional resistance to hydrogen embrittlement of the V-3Ti-0.5Si alloy in comparison to the V-15Cr-5Ti alloy. Also, the H concentration distributions in the V-15Cr-5Ti and V-3Ti-0.5Si alloys were determined after immersion in liquid lithium at 500°C for 20-25 h. The H concentration in the V-15Cr-5Ti alloy decreased from an initial level of 0.19 at. % to 0.002 at. % and the H concentration in the V-3Ti-0.5Si alloy decreased from 0.31 at. % to 0.34 at. % after the lithium exposure. These results suggest that the greater loss of ductility exhibited by the V-15Cr-5Ti alloy, in comparison to the V-3Ti-1Si and V-20Ti alloys, on neutron irradiation is not attributable to an increased H concentration. Significant amounts of H were evolved from corrosion products formed on the surface of the V-31-0.5Si alloy during the lithium exposure. The V-3Ti-0.5Si alloy has a twofold greater propensity for H uptake than the V-15Cr-5Ti alloy. 10 references, 9 figures, 3 tables.

10461 (DOE/ER—0313/4, pp 168-172) **Microstructure of several vanadium alloys after irradiation in FFTF at 420°C to 82 dpa.** Braski, D.N. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The damage produced by neutron irradiation in the microstructures of the four vanadium alloys was qualitatively the same. Except for V-20Ti, no new precipitate phases were observed after irradiation. Fine, rod-shaped particles were found surrounding the pre-existing titanium carbon nitrides in V-20Ti. The V-15Cr-5Ti and Vanstar-7 alloys exhibited very low swelling, while V-3Ti-1Si and V-20Ti displayed slightly higher values (i.e., > 0.1%). The swelling in V-3Ti-1Si increased with increasing helium content be-

cause the helium boosted cavity nucleation with only a slight loss in average cavity size. 5 references, 5 figures, 2 tables.

**10462** (DOE/ER—0313/4, pp 173-175) **Analysis of copper and copper alloys after low-level tritium charging.** Zinkle, S.J. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Copper and the copper alloys Cu-Zr and Cu-Cr-Zr-Mg were implanted with ~ 50 appb He using the tritium trick. The measured helium concentration was an order-of-magnitude higher than that expected from calculations based on the established solubility of tritium in copper. A comparison with specimens annealed in hydrogen showed that 50 appb He does not have an appreciable effect on the tensile properties of any of the tested materials. 14 references, 3 tables.

**10463** (DOE/ER—0313/4, pp 176-179) **Corrosion in liquid metal environments: susceptibility of $Fe_3Al$ in a lithium thermal convection loop and mechanisms of irregular attack by lithium and lead-lithium.** Tortorelli, P.F. Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The purpose of this work is to characterize the corrosion of candidate or model fusion materials by slowly flowing lithium and Pb-17 at. % in the presence of a temperature gradient. Dissolution and deposition rates are measured as a function of alloy composition, exposure time, temperature, and additions to the liquid metals. These measurements are combined with microstructural analyses of the specimen surfaces to establish mechanisms and rate-controlling processes for the corrosion and mass transfer reactions, determine the suitability of particular materials for service in specific liquid metal environments, and provide input into fusion materials development. Despite its attractiveness as a low activation material, $Fe_2Al$ was found to have relatively poor corrosion resistance in molten lithium at 500°C. The corrosion of another ordered metallic alloy, Fe-Ni-V, by lithium at 600°C was found to be a two-stage process involving preferential depletion of nickel and nitriding and/or carburizing of vanadium. Results from percolation theory showed that a reactive path model could not explain the irregular attack induced by preferential depletion in a lead-lithium environment; a model based on surface destabilization appeared to be more appropriate. 17 references, 3 figures, 1 table.

**10464** (DOE/ER—0313/4, pp 180-183) **Corrosion and mass transfer in lithium 12Cr-1MoVW steel systems.** Bell, G.E.; Tortorelli, P.F.; Abdou, M.A. (Univ. of California, Los Angeles (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

A corrosion and mass transport study utilizing two lithium/12Cr-1MoVW steel thermal convection loops was completed after 3040 and 2510 h at maximum temperatures of 505 and 655°C, respectively. Mass transfer was not a simple function of temperature and elemental solubility and temperature gradient played an important role. At temperatures above 580°C, mass transfer was dominated by temperature gradient while, between 450 and 580°C, it appeared to be controlled by surface reactions involving nitrogen, lithium, and chromium and surface carbides. The corrosion rates from this work were significantly lower than those adopted in recent blanket studies. 15 references, 3 figures.

**10465** (DOE/ER—0313/4, pp 184-188) **Assessment of stress-corrosion cracking for near-term fusion reactors.** Jones, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this evaluation was to identify and assess the potential for stress-corrosion cracking (SCC) in near-term, water cooled fusion reactors. Identification of critical issues, evaluation of the relevant stress-corrosion data base and recommendations on materials selection was also an objective of this study. Water-cooled, near-term fusion reactors will operate under conditions at which SCC is possible; however, control of material purity and fabrication procedures can reduce the probability of crack initiation and growth. Some of the critical issues identified in this evaluation are: 1) will irradiation-assisted stress-corrosion cracking (IASCC) occur at temperatures lower than 100°C, and if so, is the neutron fluence threshold equal to or less than near-term reactor fluences? 2) will aqueous-salt solutions cause SCC? and 3) will radiolysis accelerate SCC in clean water or aqueous-salt coolants? 21 references, 3 figures.

**10466** (DOE/ER—0313/4, pp 189-192) **Corrosion and compatibility studies in flowing lithium environments.** Chopra, O.K.; Hull, A.B.; Smith, D.L. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this program is to investigate the influence of a flowing lithium environment on the corrosion behavior and mechanical properties of structural alloys under conditions of interest for fusion reactors. Corrosion rates are determined by measuring weight change and depth of penetration of internal corrosion as a function of time, temperature, and liquid metal purity. These measurements, coupled with metallographic evaluation of the alloy surface, are used to establish the mechanism and rate-controlling processes of the corrosion reactions. Studies of the long-term environmental effects on mechanical properties focus on nonmetallic element transfer and surface reactions. This report describes a new experimental facility for investigating the corrosion/mass transfer/deposition mechanisms that are anticipated when liquid lithium is used as a tritium breeding material for fusion reactors. 11 references, 1 figure, 2 tables.

**10467** (DOE/ER—0313/4, pp 194-197) **Mechanical properties of solid breeder materials.** Chu, C.Y.; Poeppel, R.B.; Singh, J.P.; Goretta, K.C. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Lithium-bearing ceramics are being considered as blanket materials for the breeding of tritium in fusion power reactors. Lithium orthosilicate ($Li_4SiO_4$) is a potential breeder material because of its high lithium content and high stability relative to other lithium-containing ceramics. Room temperature strength and toughness and high-temperature creep resistance are important properties relative to installation and operation of breeder blankets, and are therefore essential for designing an efficient blanket. Room temperature strength, fracture toughness, Young's modulus, and thermal-shock resistance were determined for 68 to 98% dense lithium orthosilicate ($Li_2SiO_4$) specimens. In the low-density regime, both strength and fracture toughness were controlled by the density of the specimen. At high density, the strength depends on grain size. Young's modulus values ranged from 30 to 103 GPa for densities ranging from 68 to 98% TD. A critical quenching temperature difference in the range of 150 to 170°C was observed in thermal-shock tests of bar specimens. Steady-state creep tests indicated that 90% dense $Li_4SiO_4$ fractures at $T \leqq 800$°C before reaching steady state and deforms plastically at above 900°C. At 900°C, it is more creep-resistant than $Li_2O$, about equal to $Li_2ZrO_3$, and less creep-resistant than $LiAlO_2$ and $Li_2SiO_3$. 4 references, 4 figures, 1 table.

**10468** (DOE/ER—0313/4, pp 198-201) **Adsorption, dissolution, and desorption characteristics of the $LiAlO_2$-$H_2O$ system.** Fischer, A.K.; Johnson, C.E. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

Adsorption of $H_2O$, dissolution of $OH^-$, and rates of evolution of $H_2O(g)$ are being measured for the $LiAlO_2$-$H_2O(g)$ system to provide thermodynamic and kinetic data for these processes for $LiAlO_2$, a candidate for a tritium breeder in fusion reactors. Such data relate to the issues of tritium retention and release, and, hence,

to concerns about tritium inventory in ceramic tritium breeder materials. The information will enable (1) comparison of candidate breeder materials, (2) calculation of operating conditions, and (3) elucidation of the principles underlying the behavior of tritium in breeder materials. The most recent corrections have been applied to the isotherms for $H_2O$ adsorption and $OH^-$ solubility on and in $LiAlO_2$ for the temperatures of 400, 500, and 600°C. For adsorption, these corrections are for the dissolution process that proceeds simultaneously with adsorption. For solubility, the corrections are for residual hydroxide corresponding to baseline conditions. The observed higher degree of adsorption at 500°C compared with that at 400°C is to be understood as reflecting two chemisorption processes with different activation energies. An atomistic basis for the distinction is given. Solubility decreases with rising temperature. 4 figures.

10469 (DOE/ER—0313/4, pp 202-204) **Modeling of tritium transport in ceramic breeder materials.** Kopasz, J.P.; Johnson, C.E. (Argonne National Lab., IL (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this work is to develop a comprehensive model of tritium transport through a ceramic breeder material. The model will enable one to compare the relative contributions of the different transport processes; such as bulk diffusion, grain boundary diffusion, desorption, permeation and trapping, to the total tritium inventory and to the release kinetics. It may also suggest ways in which the tritium inventory can be reduced. A computer program for tritium release determined by diffusion and desorption has been developed. This model gives better agreement with experimental data than does a pure diffusion model. An investigation of the temperature and grain size dependence of the diffusion-desorption model indicates that for $Li_2O$ diffusion dominates the tritium release at high temperatures for large grain radius samples and desorption dominates at low temperatures for samples with a small grain radius. 9 references, 1 figure.

10470 (DOE/ER—0313/4, pp 205-209) **Effect of irradiation on the thermal conductivity of $LiAlO_2$ and $Li_2O$.** Hollenberg, G.W.; Ethridge, J.L.; Baker, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

$LiAlO_2$ and $Li_2O$ are two candidates for tritium breeder materials in fusion reactors which must operate within specific design temperature windows. Although irradiation may cause large reductions in thermal conductivity at room temperature, the effect at operating temperatures ($T > 400$°C) is much less. Hence, these solid breeder materials are expected to maintain temperatures within their initial temperature windows during operation. 14 references, 2 figures, 1 table.

10471 (DOE/ER—0313/4, pp 212-216) **Mechanical reliability of fusion ceramics for ECRH in the context of radiation damage.** Frost, H.M.; Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)). Aug 1988. NTIS, PC A10/MF A01. Order Number DE89001585/JAW. (ORNL/M—594).

In Fusion reactor materials: semiannual progress report for the period ending March 31, 1988.

The objective of this work is to develop and apply an analytical approach for assessing the impact on service lifetime of radiation damage in ceramics intended for magnetic fusion energy (MFE) applications entailing electron cyclotron resonance heating (ECRH) of fusion plasmas. Most reports of radiation-induced changes in dielectric properties and thermal conductivities of insulating ceramics for MFE applications do not include quantitative assessments of the impact of such changes on material or device failure. Details are presented here on calculations based on a model published for some time but not applied until very recently to radiation damage. It incorporates the Weibull distribution for fracture statistics, such as used in the mid 1980's for gyrotron windows in a radiationless environment. A major consequence of applying this and another model in the context of an alumina ($\alpha$-$Al_2O_3$) or beryllia rf window subject (during ECRH use) to dielectrc and thermal-conductivity damage and strength changes, as induced by fast neutrons, involves reductions in service lifetimes by orders or magnitude. 8 references, 1 table.

10472 (DOE/ER/53245—2) **Design studies of low aspect-ratio torsatrons: Final performance report, 1 June 1987--31 May 1988.** Hanson, J.D. (Auburn Univ., AL (USA). Dept. of Physics). 15 Oct 1988. Contract FG05-87ER53245. 10p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004859/JAW.

Low Aspect Ratio is one of many design criteria for torsatrons. A new magnetic field design technique based on the Hamiltonian structure of magnetic field line flow is used to investigate feasible torsatron configurations. Significant improvements have been made in the computer code IFS. The problem of too large a magnetic axis wobble has been solved with the addition of an $l = 1$ $m = 6$ helical coil. A practical non-intersecting coil set has been designed. 4 refs., 2 figs., 1 tab.

10473 (DOE/ET/51013—252) **Studies of a neutralizer for high energy, high brightness, and low energy spread ion beams for plasma heating and other applications.** Wei, J.; Bromberg, L.; Cohn, D.R. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1988. Contract AC02-78ET51013. 12p. (PFC/RR—88-8). NTIS, PC A03/MF A01 - OSTI. Order Number DE89005036/JAW.

The concept of using mutual charge exchange to create high energy and high power neutral beams is described. Analytical models to simulate beam neutralization are derived and solved numerically. 4 refs., 6 figs.

10474 (DOE/ET/51013—254) **The physics and engineering of Alcator C-Mod.** Hutchinson, I.H.; Becker, H.; Bonoli, P.; Diatchenko, N.; Fairfax, S.; Fiore, C.; Granetz, R.; Greenwald, M.; Gwinn, D.; Hakkarainen, S. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1988. Contract AC02-78ET51013. 48p. (PFC/RR—88-11). NTIS, PC A03/MF A01 - OSTI. Order Number TI89004053/JAW.

Alcator C-Mod is a new tokamak under construction at M.I.T. that promises to play an important and flexible role in the international fusion research effort. The physics and engineering features of the tokamak are described, giving an overview of the machine and plasma configurations. On the basis of empirical scaling laws, we predict the plasma confinement performance to be near DT equivalent breakeven. The planned experimental program is addressed to many of the vital physics questions still uncertain in high-performance tokamak plasma behaviour as well as to the investigation of innovative approaches to tokamak improvement. 17 refs., 17 figs., 3 tabs.

10475 (EGG-PHY—8304) **The INEL beryllium multiplication experiment: Annual report, FY88.** Smith, J.R.; King, J.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1988. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004876/JAW.

Activities during FY88 were devoted to the preparations for the performance of an experiment to measure the multiplication of 14-MeV neutrons in bulk beryllium. A Kaman Model A-1254 Neutron Generator was obtained as excess property from Sandia National Laboratory, refurbished, and installed at the INEL manganese bath. The necessary electronic equipment was procured, control and signal lines were run in conduit between the experimental areas and the control room, a mechanism for handling the beryllium samples was devised, a beryllium shell was obtained to fill the void in the existing set of samples, and software was written for accumulating and analyzing the data from the experiment. Preliminary estimates have been made of the nature, magnitude, and uncertainty of the various corrections that must be applied to the data. All components are now in place for the performance of the beryllium multiplication experiment. 13 refs., 9 figs., 2 tabs.

10476 **(EUR—11384) On the signification of dislocation sink strength for microstructure evolution by irradiation.** Steinbach, E. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1988. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756012/JAW.

The model of a lossy continuum is used to derive, for the first time, exactly the synergistic influence of the elastic interaction, additional sinks and rate limitation on the point defect flux to a dislocation by means of the elastic field model of a dislocation. Taking into consideration these results, the derivation of self-consistent, approximative formulae for dislocation sink strengths is possible. The latter permit a powerful application within the rate theory of radiation damage. The use of data produced by electron and ion irradiation enables calibration of all fit parameters. Predictions outside the existing data domain can thus be made on the swelling behaviour of materials. This adjustment, which provides an excellent description of hte experimental results, leads to new expressions for the rate limitation and cascade collapse efficiency parameters. By using these parameters it is possible to predict the swelling behaviour in the case of neutron irradiation. When comparing these with experimental swelling curves, there is a very strong correspondence.

10477 **(GA-A—18972) Analog computation system for plasma position and shape control.** Haskovec, J.S.; Kellman, A.G.; Moore, C.D.; Strait, E.J.; Taylor, T.S. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 3p. (CONF-871007—137). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004032/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Part of the DIII-D upgrade of the Doublet III. Fusion experiment involves incorporation of more extensive feedback control of various plasma parameters. More than 200 sensors and measuring instruments generate the primary analog signals during the experiment. These signals are conditioned and transformed to standard voltages by amplifiers, integrators, and sometimes more complicated circuits. To obtain suitable feedback control variables, subsets of primary signals are combined in the form of mathematical functions. A five-input summing amplifier, a two-input divider/two-input multiplier, and a three-input summing amplifier with a two-input multiplier are the standard module functions. In order to eliminate stability problems in feedback loops, the transfer function of the computing circuits must introduce minimal time delay in the required frequency band, even if multiple cascading is used. Long term stability and accuracy is also required, along with high reliability, to save limited maintenance resources and minimize shutdown time of the experiment. During the initial stage of implementation, high flexibility in the circuit configuration and programming was required because of the empirical nature of many of the parameters. Digital and analog solutions were considered before a modular analog system was selected. The VME mechanical standard was chosen mainly because of the high density backplane connectors and availability of shielded backplanes and flat cables, which provide easy and inexpensive signal routing to any module in the system. All inputs are single-ended. Low output noise levels permit daisy chaining of modules which allows implementation of complicated functions. All inputs and outputs are also accessible via miniature coaxial connectors on the front panel, together with polarity and range switches and ten turn precision potentiometers for constant factor selection. 3 figs.

10478 **(GA-A—18974) Thermal-stress analysis and testing of DIII-D armor tiles.** Baxi, C.B.; Anderson, P.M.; Reis, E.E.; Smith, J.P.; Smith, P.D.; Croesmann, C.; Watkins, J.; Whitley, J. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—131). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004031/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

It is planned to install about 1500 new armor tiles in the DIII-D tokamak. The armor tiles currently installed in DIII-D are made by brazing Poco AXF-5Q graphite onto Inconel X-750 stock. A small percentage of these have failed by breakage of graphite. These failures were believed to be related to significant residual stress remaining in graphite after brazing. Hence, an effort was undertaken to improve the design with all-graphite tiles. Three criteria must be satisfied by the armor tiles and the hardware used to attach the tiles to the vessel walls: tiles should not structurally fail, peak tile temperature must be less than 2500 K, and peak vessel stresses must be below acceptable levels. A number of alternate design concepts were first analyzed with the two-dimensional finite element codes TOPAZ2D and NIKE2D. Promising designs were optimized for best parameters such as thicknesses, etc. The two best designs were further analyzed for thermal stresses with the three-dimensional codes P/THERMAL and P/STRESS. Prototype tiles of a number of materials were fabricated by GA and tested at the Plasma Materials Test Facility of the Sandia National Laboratory at Albuquerque. The tests simulated the heat flux and cooling conditions in DIII-D. This paper describes the 2-D and 3-D thermal stress analyses, the test results and logic which led to the selected design of the DIII-D armor tiles. 5 refs., 7 figs., 3 tabs.

10479 **(GA-A—18976) Assessment of vertical motions of DIII-D vacuum vessel.** Reis, E.E.; Anderson, P.M.; Lightner, S.; Luxon, J.L.; Petersen, P.I. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 5p. (CONF-871007—136). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004033/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Vertical motions of the DIII-D vacuum vessel have been observed to occur after disruptions of diverted plasmas. The dynamic response of the vessel was measured and recorded by a motion detector system. Although the physics involved in the production of the vertical loads is not yet clearly understood, the vessel motion correlated with a rapid vertical movement of the plasma preceding the current quench which occurred during a disruption. The initial motion of the vessel is downward when the plasma moves downward during the disruption. Motion of the plasma alone without a disruption was not enough to produce significant displacements of the vessel. An analytical model was developed to correlate vessel loads and stresses to the vertical displacements measured at the top of the vessel. A number of dynamic response analyses were performed with the structural model to establish a base loading condition that produces results similar to the measured values. The purpose of this study was to provide safe limits on the operation of DIII-D with diverted plasmas so that the vacuum vessel will not be overstressed when a disruption occurs. 4 refs., 7 figs., 1 tab.

10480 **(GA-A—18977) Design of DIII-D armor tiles.** Smith, J.P.; Anderson, P.M.; Baxi, C.B.; Reis, E.E.; Smith, P.D. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 3p. (CONF-871007—133). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004036/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An upgrade of the vessel protection system for DIII-D is in progress. The ceiling, floor, and inner wall are being armored to enable operation of double null diverted plasmas and to enable the use of the inner wall as a limiting surface. The present armor configuration is partial coverage of the vessel wall with a combination of Inconel X-750 tiles and Inconel tiles with 1 cm graphite caps brazed to the plasma facing surface. The graphite is located only in the areas of neutral beam shinethrough and divertor targets on the floor. The existing brazed design has had limited success at the present operational energy levels which are below the capability of the machine. The new armor tile design utilizes the existing mounting studs and stud pattern in the vessel and is compatible with existing and planned diagnostics. The 10 minute duration between pulses requires the tiles to be conductively cooled by the vessel wall. Using two and three-dimensional analyses, the file design is optimized for thermal loading. Minimizing the stresses around the hold-down and eliminating stress concentrators is also emphasized in the design. The tiles are made from graphite, and a process to select a particular grade of graphite was developed. Thermal shock parameters have been compared, and testing of the graphites for thermal shock in an ion beam test facility has been carried out. The design of the tile fastener system incorporates the hold-down forces re-

quired for thermal conductance to the vessel and for holding the tile against eddy current forces. Special graphite materials are being used for tiles which have instrumentation mounted in them. A carbon-carbon composite with random fiber reinforcement was chosen for special tiles. 4 refs., 4 figs.

10481 **(GA-A—18992) Performance of the DIII-D neutral beam injection system.** Kim, J.; Callis, R.W.; Colleraine, A.P.; Cummings, J.; Glad, A.S.; Gootgeld, A.M.; Haskovec, J.S.; Hong, R.; Kellman, D.H.; Langhorn, A.R. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 7p. (CONF-871007—130). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004030/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

During the upgrade of the Doublet III tokamak, the neutral beam injection system was also modified to accommodate long pulse sources and to utilize the larger entrance apertures to the torus vessel. All four beamlines on DIII-D are now in operation with a total of eight common long pulse sources. These have exhibited easier conditioning and good reproducibility. Performance results of the beamlines and supporting systems are presented, and the observed beam properties are discussed. 22 refs., 4 figs.

10482 **(GA-A—18993) Operational experience of the DIII-D neutral beam 12 cm x 48 cm long pulse source.** Hong, R.; Colleraine, A.P.; Haskovec, J.S.; Kellman, D.H.; Kim, J.; Nerem, A.; Phillips, J.C.; Sleaford, B.W.; Wight, J.J.; Vella, M. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—135). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004034/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

All four neutral beamline of the DIII-D tokamak have been converted to long pulse source operation. These common long pulse sources (CLPS) were designed for full power operation at 80 kV, 80 A, 5 sec with hydrogen. The CLPS plasma generator is equipped with cusp magnets and operates in the emission limited regime. The accelerator has an actively cooled tetrode geometry with a 10 m focus in one direction. Each new CLPS requires conditioning of the arc chamber prior to any attempt at beam extraction. It was found that the filament temperature plays an important role in the performance of the arc chamber, and that the arc operated more smoothly with the arc power supply in an unregulated mode and the filament supply in a constant voltage mode. To avoid the collapse of the voltage between the plasma and gradient grids at initial beam formation, a capacitive compensation network between the grids was added. Initial beam extraction typically started at 40 kV and progressed quickly to the full 80 kV capability with little to no degradation during shutdown periods. 4 refs., 12 figs.

10483 **(GA-A—18995) Stray magnetic field interference with ion source operation on the DIII-D beamline.** Colleraine, A.P.; Hong, R.; Kim, J.; Sleaford, B.W. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 6p. (CONF-871007—129). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004029/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Measurements were made of the stray magnetic fields originating from the tokamak magnetic coils at the location of the ion source. The ohmic coils are the primary source of stray fields. Without the shield housing the dominant stray field was in the vertical direction. When the shield housing was in place, the radial component and the vertical component inside the housing become comparable. The short pulse ion sources exhibited clear degradation in discharge stability when the stray fields exceeded 1 gauss, whereas the common long pulse ion source appears quite immune to the stray fields up to a few gauss. 7 refs., 4 figs.

10484 **(GA-A—18996) Beam transmission properties in the DIII-D neutral beamlines.** Wight, J.J.; Colleraine, A.P.; Hong, R.; Kim, J.; Phillips, J.C.; Sleaford, B.W. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 4p. (CONF-871007—134). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004035/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Neutral beam transmission properties in DIII-D beamlines have been investigated by waterflow calorimetry measurements. Recent waterflow calorimetry measurements under long pulse beam operations have revealed a fairly high variation among the eight beams, with the transmission efficiency to the calorimeter ranging from 69% to 78%. A hydrogen injected power of 1.6 MW has been obtained from the best ion source. 7 refs., 4 figs., 4 tabs.

10485 **(GA-A—19387) Thermal system analysis of Compact Ignition Tokamak.** Baxi, C.B. (General Atomics Co., San Diego, CA (USA)). Sep 1988. Contract AC03-84ER53158. 5p. (CONF-880929—10). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004362/JAW.

From 15. symposium on fusion technology; Utrecht, Netherlands (19 Sep 1988).

This paper describes the thermal system analysis performed for the conceptual design of the Compact Ignition Tokamak (CIT). The CIT vacuum vessel and the first wall will be baked at a temperature of 350{degree}C. The maximum fusion power during plasma operation will be 600 MW for 5 seconds at an interval of 1 hour. The coolant during bakeout and operation will be nitrogen or other suitable gas. In order to analyze the above conditions, a thermal system analysis code (THESYS), previously used for design and analysis of the DIII-D tokamak, was modified and improved for application to CIT. THESYS is a 2-D transient thermal analysis code which models components of the first wall of the tokamak, such as limiters and divertors, the vacuum vessel wall, the insulation system, and the coolant loop. Analytical results for the DIII-D tokamak that were obtained with the THESYS codes show good agreement with the observed results. The THESYS codes was used for design and analysis of the CIT vacuum vessel system for bakeout and plasma operation. The results of the bakeout analysis indicate that a bakeout at 350{degree}C is feasible by using hot nitrogen gas. A system analysis was also performed for the double-null plasma divertor operation and shows that 1 hour is sufficient to cool down the vessel between pulses. THESYS could be used for analysis of other devices, such as JET, JT-60, and ITER. 4 refs., 7 figs., 2 tabs.

10486 **(INIS-mf—11854) Long-range concept for controlled thermonuclear fusion.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 20 May 1988. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756103/JAW.

BMFT - Pressereferat.; no. 19/88.

The introductory part discusses general aspects of fusion research such as the technological potentials and the main approaches, the physical research results achieved in the last decade, and physical and technical key problems, together with alternative plasma device design. The European research programme and activities are compared with what has been established so far in the USA, the USSR, and Japan. International cooperation in the field of thermonuclear reactor research is another aspect. The survey informs about the established programmes, the activities of West Germany, the capital expenditure for the European and the German programmes, about environmental aspects and safety engineering, and about the economic potentials.

10487 (INIS-SU—60/A, pp 66-69) **Influence of a priori information on the accuracy restore of the thermonuclear neutron spectra.** Konakov, S.A.; Chuvilin, D.Yu.; Bondars, Kh.Ya.; Niedritis, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.

In Thermonuclear synthesis. Scientific-technical collection.

Results of numerical investigation of unfolded neutron spectrum influence on the accuracy of a priori information for typical thermonuclear reactor spectra are presented. Unfolding was carried out using SAND-II program. The carried out calculations showed that for specially plotted smooth "thermonuclear" spectra in some energy range (4-13 MeV) correction of a priori spectrum by reference to detector activation integrals doesn't take place. This is due to small contribution of this neutron energy region to the total flux

(and, consequently, to activation integral) and due to absence of detectors sensitive to 4-13 MeV neutrons only. In the neutron energy range where detectors show maximum activity, correction of a priori spectrum takes place and unfolded and initial spectra are brought together. 7 refs.; 2 figs.

10488 (INIS-SU—60/A, pp 41-45) **Choice and computation concept of the L-2M stellarator magnetic structure.** Danilkin, I.S.; Khadin, O.E. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Fundamental statements forming so-called topology-stable magnetic configuration of a stellarator with a strong magnetic shear are considered. This concept represents one of two approaches dominating in the world stellarator program of CTR (the second one is a concept of a shearless stellarator "Wendelstein" proposed in FRG) Methods are outlined for calculating the stellarator magnetic structure by means of the code based in analytic consideration of the magnetic field for a circular torus having helical winding. 5 refs.; 2 figs.; 3 tabs.

10489 (INIS-SU—60/A, pp 46-50) **Concept of the l=2 torsatron with an additional toroidal field.** Bykov, V.E.; Georgievskij, A.V.; Demchenko, V.V. and others. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

An analysis is presented for the l=2 torsatron with a relatively small pitch angle of the helical winding, which necessitates the employment of an additional toroidal field. The main advantage of this torsatron design in contrast to a "pure" torsatron is the reduction of both the current of the helical winding and the helical ripples of the magnetic field. This facilitates the fabrication practice of the helical winding and also reduces the plasma losses caused by helical ripples of the magnetic field. Described is the experimental device "Uragan-2M" of the design considered. Possible reactor applications of this design are discussed. 5 refs.; 5 figs.

10490 (INIS-SU—60/A, pp 61-62) **Power compression of microsecond pulse current generator with a current plasma switch in magnetic field.** Golovanov, Yu.P.; Dolgachev, G.I.; Zakatov, L.P.; Skoryupin, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Results of experiments on power compression of microsecond pulse current generator (PCG) with a current plasma switch (CPS) in magnetic field loaded with electron diode are presented. The carried out experiments permitted to make a conclusion that 1) at initial voltage of 40-50 kV a stable CPS closure with plasma transverse magnetic field is observed; 2) turn off takes place at a time when the charge passing through CPS attains 5-10 kA.μs per one plasma channel (plasma gun) or 0.25-0.5 MA.μs per one length unit of CPS in metres; 3) change from the voltage pulse generator to pulse current generator sufficiently simplifies the accelerator design. 5 refs.; 3 figs.

10491 (INIS-SU—60/A, pp 57-61) **Peculiarities of laser cryogenic target destruction and their injection into powerful laser focus.** Koresheva, E.R.; Merkul'ev, Yu.A.; Nikitenko, A.I.; Osipov, I.E.; Tolokonnikov, S.M. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

The formation conditions for cryogenic targets with homogeneous spherically symmetric layer of solid fuel are experimentally found. A device for cryogenic target fabrication, storage and injection into laser focus is suggested, its capacity for work at 80 and 4.2 K is manifested. On the basis of carried out investigations a program of cryogenic gun construction for cryogenic targets fabrication and injection into laser focus is implemented. The device principle of operation is based on electromagnetic acceleration of ferromagnetic pusher with a target. Use of a pusher distinguishes the developed device from the earlier suggested. This injection element also increases the cryogenic layer lifetime during acceleration. The carried out experiments have demonstrated possibility of using electromagnetic acceleration for injection of cryogenic targets into powerful laser focus. The merits of developed device are possibilities of contactless, frequency and rapid target injection. 7 refs.; 8 figs.

10492 (INIS-SU—60/A, pp 30-36) **Radiation situation at a tokamak with high magnetic field and adiabatic compression of DT plasma.** Azizov, Eh.A.; Mel'nikov, E.A.; Rymarenko, A.I.; Sakharov, V.K.; Tagi-Zade, R.F.; Frunze, V.V.; Chuyanov, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

The results of computer calculations on gamma-fields caused by construction material activation by thermonuclear neutrons with the initial energy 14.1 MeV (with successive moderation) and yield 5.10 /sup 17/ n/per pulse are presented for a tokamak with high magnetic field and adiabatic compression. 15 refs.; 5 figs.; 3 tabs.

10493 (INIS-SU—60/A, pp 63-66) **Possibility of using boron nitrides in thermonuclear reactor elements.** Buzhinskij, O.I.; Lopatin, V.V.; Kabyshev, A.V.; Opimakh, I.V. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

Electrophysical properties, thermal and radiation stability of pyrolitic boron nitride (PBN) are considered. Despite insufficient mechanical strength, PBN possesses high radiation stability, high dielectric characteristics, chemical and thermal stability, low vapor pressure at < or approx. 2000 K. Under treatment of PBN surface by carbon ion beams with the following thermal annealing a stable semiconducting surface resistance with preassigned characteristics may be produced. All this permits to recommend PBN as a shielding construction material in "tokamak" reactors. 10 refs.; 3 figs.; .

10494 (INIS-SU—60/A, pp 69-75) **Hydrogen permeability, absorption and reemission from metals interacting with the fast atoms and ions of hydrogen.** Livshits, A.I. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780043/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1.
In Thermonuclear synthesis. Scientific-technical collection.

A phenomenological description is given, which takes into account: the multi-stadia character of the process of release into the gase; the effects of the chemical composition of the surface and its dynamics; the temperature gradient. The dependence on temperature, energy, flux and surface composition is found. The stainless steel at INTOR regimes is treated as an example. 6 refs.; 2 figs.; 3 tabs.

10495 (IPPCZ—277/II, pp 40-54) **Experiments on liner acceleration in the "Modul" facility.** Bogolyubskij, S.L.; Volkovich, A.G.; Gordeev, E.M. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jul 1987. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704963/JAW. (CONF-8703303—).

From 14. Czechoslovak seminar on plasma physics and technology; Liblice, Czechoslovakia (3 Mar 1987).

The results are reported of liner implosion experiments performed on the Angara-Modul 5-01 facility. Cylindrical nitrocellulose liners (of a mean diameter of 1.9 to 2.6 cm, length of 0.5 to 1.0 cm, and total mass of 50 to 220 μg) and gas jet liners (of an inner diameter of 2.5 cm and the Mach number of 4) were used. At the load inductivity reduced to about 1 nH, the maximum liner currents exceeded 2 MA. Fast frame and streak photography in optical and X-ray regions (with MCP electron-optic image converters in the latter case), laser shadowgraphy and schlieren photography and X-ray crystal spectrographs were employed to study the liner dynamics. The radial implosion velocities up to 3.10/sup 7/ cm/s and radial compression ratios of about 10 were observed. The plasma

electron temperature at a stage of maximum compression reached 100 to 200 eV. The maximum radiated power was estimated to 3 to 5.10/sup 11/ W. (J.U.). 7 figs., 9 refs.

10496 **(IPPJ—860) Analysis for high compressible supersonic flow in converging nozzle.** Niu, Keishiro; Aoki, Takayuki. (Tokyo Inst. of Tech. (Japan)). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756047/JAW.

In a converging nozzle, fluid is shown to be compressed to a very high density, especially in supersonic region, if the initial Mach number of the fluid is large. Thus it is shown that spherical implosion can be used as a method to make high density materials.

10497 **(IPPJ—864) ECRH current drive in tokamak plasmas.** Taguchi, Masayoshi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756048/JAW.

The current drive by electron cyclotron resonance heating (ECRH) is investigated in a typical magnetic field of tokamak with circular cross section. The trapped electrons and the modification of electron-cyclotron resonance condition by the relativistic mass increase are shown to have significant effects on the efficiency of this current drive. The efficiency strongly depends on the values of the parallel velocity u/sub 0/ of resonant electrons, the inverse aspect ratio $\epsilon$, the poloidal angle $\theta$/sub 0/ of absorption point, and the relativistic parameter S, which represents the strength of the relativistic correction to the resonance condition.

10498 (IPPJ—866, pp 23-33) **Japanese materials program and FFTF.** Ishino, Shiori. (Tokyo Univ. (Japan). Faculty of Engineering). Apr 1988. NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW. (CONF-8708298—).

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

Japanese materials program has been briefly reviewed and the associated university program, which is still in a provisional stage has been described in some detail. Important elements of the university proposal will be 1) construction of a high energy high fluence neutron irradiation facility, 2) establishing or expanding local research centers including hot laboratories, and 3) promotion of fundamental studies. The FFTF/MOTA Project is a very important constituent of the whole program, the results coming out of which should be well coordinated with other fundamental research programs to extract full essence needed for the advancement of realization of fusion energy.

10499 **(IPPJ—866) Proceedings of the first Japan/U.S. FFTF/MOTA experimenters' workshop.** Doran, D.G.; Ishino, Shiori; Namba, Chusei (eds.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1988. Vp. (CONF-8708298—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE89780036/JAW.

From 1. Japan/U.S. FFTF/MOTA experimenters' workshop; Tokyo, Japan (24 Aug 1987).

Papers presented at this meeting have been abstracted and indexed separately.

10500 **(IPPJ—869) Symmetrized magnetic field configuration of low aspect ratio helical system.** Nishimura, Kiyohiko; Fujiwara, Masami. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756049/JAW.

Helical system has the attractive feature such that it can generate the closed magnetic surface by the externally wound coils only. However, there are many problems to be solved for the confinement of a reactor grade plasma in helical systems. We propose a new useful method of the coil width modulation (the modulation of the helical coil current distribution) to meet with the requirement for the magnetic configuration of a high temperature plasma confinement. This method can reduce multi-helicity (higher or satellite harmonics of the fundamental helical field) which brings many demerits into the conventional stellarator/torsatron/heliotron configuration.

10501 **(IPPJ—871) On the generation of runaway electrons and their impact to plasma facing components.** Kawamura, Takaichi; Obayashi, Haruo; Miyahara, Akira. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756051/JAW.

Runaway electrons accompanied by inductive or non-inductive plasma currents in a tokamak have severe interactions with plasma facing materials of a first wall, and influence the first wall structure due to activation and damage. In this paper, modelling of runaway electron generation near the wall in a tokamak is carried out. This includes the evaluation of acceleration along magnetic surfaces for relativistic electrons with energies larger than the runaway threshold. Penetration of runaway electrons of energy ranges from a few MeV to several ten MeV leads to gamma ray photon production by bremsstrahlung. One of the specific features of the impact on the first wall technology is that they give rise to activation due to giant resonance of the ($\gamma$,n) nuclear reaction and, as a consequence, cause a requirement of remote maintenance. The other is that they bring energy deposition at brazing areas between low Z material and metal, or at a metal itself, and they result in melting, cracking and grain growth. The methods to estimate these effects using nuclear data and material data on the basis of runaway flux modelling are introduced and examples of estimation are given.

10502 **(IPPJ—873) Modelling of the 2-dimensional structure and impurity transport for a scrape-off layer with a solid limiter.** Kawamura, T.; Ono, T.; Masuda, Y.; Reiter, D. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1988. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756053/JAW.

A 2-dimensional modelling of a scrape-off layer with a solid limiter is presented. After the plasma in a scrape-off layer is calculated by a plasma code SLIM based on the 2-dimensional fluid equations with source terms due to neutral particles, the neutral transport is calculated by a Monte Carlo code EIRENE with the use of the results by SLIM and these two calculations are iteratively performed until a nearly self-consistent result is obtained. Ionization of neutral impurity particles ejected from the first wall and random diffusion of the charged impurities across the magnetic field lines in this scrape-off layer plasma are simulated by a Monte Carlo method. From the statistical analysis on the numerical results the screening efficiency of a scrape-off layer, impurity redeposition rate and behaviour of impurities in a scrape-off layer are analyzed.

10503 **(LA-UR—88-2274) Refrigerator-cooled cryostats for research on inertial confinement fusion.** Hoffer, J.K.; Candler, R.J. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 10p. (CONF-890102—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88014327/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

In order to utilize the increased density of liquified or solidified DT fuel, one must provide means for cooling fusion targets to the range 15 K to 25 K. The heat loads at these low temperatures can be kept modest by providing adequate thermal shielding maintained near 75 K. Modern closed-cycle-helium refrigerators, operating on the Gifford-McMahon cycle, provide for both thermal loads reliably and inexpensively, thanks to the increasing implementation of the commercial cryopump. By adding a large sealed can containing helium exchange gas to the second state of the refrigerator, we create a nearly ideal environment for cryogenic fusion targets. We discuss the design and operation of two separate apparatus. One has been used almost continuously over the past two years for various inertial confinement fusion studies. 5 refs., 3 figs.

10504 **(LA-UR—88-3347) A traveling wave approach to plasma pumping for x-ray sources.** Jensen, R.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8808169—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002040/JAW.

From U.S./Japan seminar; Honolulu, HI, United States (7 Aug 1988).

Optical angular multiplexing allows the extraction of multiple short pulses from a single long pulse amplifier. In the ICF case a single short pulse is divided into many short pulses of the same temporal profile using beam splitters. The pulses are routed through the amplifier system at slightly different angles and then are played onto a small target simultaneously to produce higher instantaneous power. In the proposed scheme the pulses can be arranged to provide traveling waver excitation to facilitate amplification of spontaneous emission. 14 refs., 2 figs.

10505 **(LBL—24993-Rev.) Considerations against a force compensated coil.** Hassenzahl, W. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 4p. (CONF-880812—21-Rev.). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004700/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

The cost of structural components in a large superconducting coil may well exceed the coil and cryostat cost. As a result, the idea of constructing a system composed of two different coil types assembled in such a way that the sources balance and reduce the total structural requirement is oft proposed. A suitable geometry has never been found for the fundamental reason that there can be no force compensated solution. In this paper, the general problem is presented and an analysis of the energy stored and stresses produced in the structure are described in a fundamental way. Finally, the relation between structural mass M and stored energy E, M ≧{rho}E/$\sigma$/sub w/, that is valid for all magnetic systems is developed, where {rho} is the density of the structure and $\sigma$/sub w/ is the working stress in the structure. 12 refs., 2 figs.

10506 **(PPPL—2568) A two-dimensional particle simulation of the magnetopause current layer.** Berchem, J.; Okuda, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004629/JAW.

We have developed a 2{1/2}-D (x, y, v/sub x/, v/sub y/, v/sub z/) electromagnetic code to study the formation and the stability of the magnetopause current layer. This code computes the trajectories of ion and electron particles in their self-consistently generated electromagnetic field and an externally imposed 2-D vacuum dipolar magnetic field. The results presented here are obtained for the simulation of the solar wind-magnetosphere interaction in the subsolar region of the equatorial plane. We observe the self-consistent establishment of a current layer resulting from both diamagnetic drift and E {times} B drift due to the charge separation. The simulation results show that during the establishment of the current layer, its thickness is of the order of the hybrid gyroradius {rho}/sub H/ = $\sqrt{}${rho}/sub i/{rho}/sub e/ predicted by the Ferraro-Rosenbluth model. However, diagnostics indicate that the current sheet is subject to an instability which broadens the width of the current layer. Ripples with amplitudes of the order of the ion gyroradius appear at the interface between the field and the particles. These pertubations are observed both on the electrostatic field and on the compressional component of the magnetic field. This instability has a frequency of the order of the local ion cyclotron frequency. However, the modulation propagates in the same direction as the electron diamagnetic drift which indicates that the instability is not a classical gradient-driven instability, such as the lower hybrid or ion drift cyclotron instabilities. The nonlinear phase of the instability is characterized by the filamentation of the current layer which causes anomalous diffusion inside the central current sheet. 79 refs., 7 figs.

10507 **(PPPL—2570) First-wall conditioning for enhanced confinement discharges and the DT experiments in TFTR.** Dylla, H.F.; Ulrickson, M.; Bell, M.G.; Owens, D.K.; Buchenauer, D.; Budny, R.V.; Hill, K.W.; Kilpatrick, S.J.; Manos, D.M.; LaMarche, P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 24p. (CONF-880512—17). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004631/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

The conditioning techniques applied to the TFTR first-wall configuration that will be in place for the DT experiments in 1990–1991 are reviewed. Of primary interest is the helium conditioning procedure that was developed to control hydrogenic recycling from the graphite, inner-wall bumper limiter. Operation of TFTR over the plasma density range for gas-fueled ohmic plasmas, {bar n}/sub e/ = (2 {minus} 5) {times} $10^{19}$ m/sup {minus}3/, typically results in hydrogenic recycling coefficients near unity. The use of the helium conditioning procedure produced recycling coefficients as low as 0.5, and decreased the minimum ohmic plasma density to {bar n}/sub e/ = 0.5 {times} $10^{19}$ m/sup {minus}3/ at I/sub p/ = 0.8 MA. Low density ohmic target plasmas with low recycling conditions are prerequisite conditions for the enhanced confinement (e.g., "supershot"), neutral-beam-heated discharges observed in TFTR during 1986-1987, which is the primary mode being considered for study in the DT experiments. The recycling changes induced by the helium conditioning procedure are believed to be the result of a plasma pumping effect in the graphite induced by He and C ion desorption of hydrogenic species from the near-surface (< 20 nm) layer of the limiter. The capacity of the conditioned limiter to pump gas-fueled, and neutral-beam-fueled discharges is compared. The helium conditioning technique is also beneficial for isotopic exchange and for minimizing the in-vessel tritium inventory. 31 refs., 7 figs., 2 tabs.

10508 **(PPPL—2572) Deuterium pumping speed measurements on 77 K cryopanels and implications for D-T retention in neutral beam systems.** Dylla, H.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1988. Contract AC02-76CH03073. 26p. (CONF-881002—34). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004633/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

An upper limit for the pumping speed of deuterium on 77 K surfaces has been determined by in-situ pressure measurements in a TFTR neutral beam line pumped by 423 $m^2$ of $LN_2$-cooled cryopanels. The measurement has importance for estimating the tritium retention in the beam line following operation of the ion sources with tritium. No $D_2$ pumping was observed. An upper limit for $D_2$ pumping on 77 K surfaces of $\leqq 2.4 \times 10^{-7}$ l/s $cm^2$ was determined, corresponding to a $D_2$ sticking coefficient of $\leqq 1.5 \times 10^{-8}$. Based on the upper limit a D-T retention factor, equal to the ratio of retained D-T to D-T input, has been determined to be $\leqq 5 \times 10^{-3}$. This upper limit for D-T retention bounds the tritium inventory within the beam line to a small fraction of the tritium throughput. Comparably small upper limits for hydrogenic sticking coefficients, of the order of $10^{-6}$ - $10^{-10}$, have been determined from a review of $H_2O$ cryotrapping measurements at 77 K and from the physical adsorption studies of $H_2$ on $H_2O$ at 4 K. 22 refs., 5 figs., 1 tab.

10509 **(UCRL—98440) Preventing vaporization and destructive shock waves in ICF target-chamber first walls.** Pitts, J.H.; Woodworth, J.G.; Tabak, M. (Lawrence Livermore National Lab., CA (USA)). 14 Nov 1988. Contract W-7405-ENG-48. 10p. (CONF-881031—46). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004025/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

We describe a sacrificial frozen-nitrogen x-ray and debris shield that is placed around fusion fuel pellets. The inner and outer radii of this shield are 100 and 165 mm, respectively. The shield absorbs nearly half of the fuel pellet energy and converts it into kinetic energy, spreading the energy deposition time at the target-chamber first wall by 4 orders of magnitude from {approximately}10 ns to >100 $\mu$s. We also include the design of a 1400-MJ-yield, 3-m-inner-radius aluminum target chamber with a no-vaporization first wall. With this shield, shock waves are reduced in magnitude so that no spall is predicted. The shield also adds thermal inertia, which allows 15 minutes between the removal of the cryostat (used to keep the fuel pellet and shield at liquid hydrogen temperatures before a shot) and the illumination of the fuel pellet by driver beams. 16 refs., 2 figs., 1 tab.

10510 **(UCRL—98608) Missions and design requirements for a Laboratory Microfusion Facility (LMF).** Hogan, W.J. (Lawrence Livermore National Lab., CA (USA)). 19 Sep 1988. Contract W-7405-ENG-48. 9p. (CONF-881031—43). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004024/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

Serious planning for the Laboratory Microfusion Facility (LMF), in which the ICF program plans to achieve high gain, has begun. An inter-organization DOE group has studied the design requirements for such a facility. That group concluded that the required missions of the LMF include: obtain high gain (10--100), conduct weapons physics (yields of 100--1000 MJ) conduct weapon effects (same yields), and assess ICF's potential for electric power. This paper describes the design implications of meeting these requirements. 5 refs., 2 figs., 5 tabs.

10511 **(UCRL—98627) Overview of the ICF 1000 MJ experiment chamber design.** Slaughter, D. (Lawrence Livermore National Lab., CA (USA)). 23 Sep 1988. Contract W-7405-ENG-48. 7p. (CONF-881031—50). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004883/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

A conceptual design of an experiment chamber for a high gain ICF facility (1000 MJ) is being developed. Performance goals have been established. Several design approaches are being evaluated through computer simulation, engineering analysis, and experimental testing of candidate first wall components. 10 refs., 3 figs.

10512 **(UCRL—98649) Final optic protection designs for ICF containment chambers.** Nilson, D.G.; Woodworth, J.G. (Lawrence Livermore National Lab., CA (USA)). 23 Aug 1988. Contract W-7405-ENG-48. 5p. (CONF-881031—53). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004885/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The output from a laser-driven high-fain ICF target in the laboratory microfusion facility (LMF) target chamber could produce enough x-rays, shrapnel, and debris to severely damage the laser's final optics. If the final optics were left unprotected, the replacement and reinstallation costs for each beam would exceed $40K. Assuming the laser has 68 beams, the replacement costs for each shot could reach $2.7M. To avoid these excessive costs, we must design a reliable optics protection system. This requires that we define the hazardous environment to which the optics are exposed. The geometrical layout for the 68 beams of the 10 megajoule laser shows the final optics placed at 25 meters from the target. The final optic will be a 2--5 cm thick debris shield ($40K each) which will be placed in front of a $200K focussing lens. Each of the 68 beams will deliver 150 kJ of 0.35 μm (3ω) light and will consist of either a 4 {times} 4 or a 2 {times} 8 array of beamlets, with each beamlet aperture having dimensions of 29 cm {times} 29cm. This produces a 3ω energy density at the final optic of 12J/cm² average and 225-30J/cm²peak. 8 refs., 4 figs., 1 tab.

10513 **(UCRL—98733) Cryogenic system design for a compact tokamak reactor.** Slack, D.S.; Kerns, J.A.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 28 Oct 1988. Contract W-7405-ENG-48. 6p. (CONF-890102—8). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003176/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The International Tokamak Engineering Reactor (ITER) is a program presently underway to design a next-generation tokamak reactor. The cryogenic system for this reactor must meet unusual and new requirements. Unusually high heat loads (100 kW at 4.5 K) must be handled because neutron shielding has been limited to save space in the reactor core. Also, large variations in the cryogenics loads occur over short periods of time because of the pulsed nature of some of the operating scenarios. This paper describes a workable cryogenic system design for a compact tokamak reactor such as ITER. A design analysis is presented dealing with a system that handles transient loads, coil quenches, reactor cool-down and the effect of variations in helium-supply temperatures on the cryogenic stability of the coils. 5 refs., 4 figs., 1 tab.

10514 **(UCRL—98734) Cryogenic analysis of forced-cooled, superconducting TF magnets for compact tokamak reactors.** Kerns, J.A.; Slack, D.S.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 25 Oct 1988. Contract W-7405-ENG-48. 5p. (CONF-890102—5). NTIS, PC A02/MF A01 - OSTI. Order Number DE89002879/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

Current designs for compact tokamak reactors require the toroidal- field (TF) superconducting magnets to produce fields from 10 to 15 T at the winding pack, using high-current densities to high nuclear heat loads (greater than 1 kW/coil in some instances), which are significantly greater than the conduction and radiation heat loads for which cryogenic systems are usually designed. A cryogenic system for the TF winding pack for two such tokamak designs has been verified by performing a detailed, steady-state heat-removal analysis. Helium properties along the forced-cooled conductor flow path for a range of nuclear heat loads have been calculated. The results and implications of this analysis are presented. 12 refs., 6 figs.

10515 **(UCRL—99626) Neutronics analysis of the Laboratory Microfusion Facility.** Tobin, M.T.; Singh, M.S.; Meier, W.R. (Lawrence Livermore National Lab., CA (USA)). 19 Sep 1988. Contract W-7405-ENG-48. 9p. (CONF-881031—45). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004014/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The radiological safety hazards of the experimental area (EA) for the proposed Inertial Confinement Fusion (ICF) Laboratory Microfusion Facility (LMF) have been examined. The EA includes those structures required to establish the proper pre-shot environment, point the beams, contain the pellet yield, and measure many different facets of the experiments. The radiation dose rates from neutron activation of representative target chamber materials, the laser beam tubes and the argon gas they contain, the air surrounding the chamber, and the concrete walls of the experimental area are given. Combining these results with the allowable dose rates for workers, we show how radiological considerations affect access to the inside of the target chamber and to the diagnostic platform area located outside the chamber. Waste disposal and tritium containment issues are summarized. Other neutronics issues, such as radiation damage to the final optics and neutron heating of materials placed close to the target, are also addressed. 16 refs., 2 figs., 1 tab.

10516 **Experimental and numerical study of thermal transport in 24-beam ultraviolet irradiation of spherical targets.** Barnouin, O.; Yaakobi, B.; Delettrez, J.; Epstein, R.; Jaanimagi, P.; Goldman, L.M. (Laboratory For Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 14623-1299). *Journal of Applied Physics;* **65**: No. 3, 969-977(1 Feb 1989).

A series of thermal transport experiments using spectral-line signature and ion expansion measurements has been performed in spherical geometry using the 24 UV-converted beams of the Omega laser system at the Laboratory for Laser Energetics of the University of Rochester. Comparison with previous experiments employing only six beams shows a much better agreement in the mass ablation rate, when using 24 beams, between experimental results obtained from charge collectors and code simulations using a flux limiter of 0.1. The influence of nonuniformities in the irradiation, x-ray line reabsorption, and ionization time lag (non-LTE effects) were studied with the help of a collisional-radiative model. These processes were found to alter the falloff rates (determined mainly by the radical profile of the temperature) of the relative x-ray line intensity with overcoat thickness. With these effects included, agreement between calculated and measured burnthrough curves is greatly improved.

10517 **$H^-$ production in a small multicusp ion source with addition of barium.** Walther, S.R.; Leung, K.N.; Kunkel, W.B. (Accelerator and Fusion Research Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Applied Physics Letters;* **54**: No. 3, 210-212(16 Jan 1989).

The effect on $H^-$ production by adding barium to a hydrogen discharge, in a small magnetically filtered multicusp ion source, has been investigated. It is found that the addition of barium can increase the $H^-$ output by a factor of 30. A strong dependence of $H^-$ output on the temperature of the ion source wall has also been observed.

10518 **Extreme-ultraviolet illumination effects on the PBFA-I magnetically insulated ion diode.** Maenchen, J.E.; Woodworth, J.R.; Mehlhorn, T.A.; Renk, T.; Ruiz, C.L.; Foltz, B.W.; Jaramillo, W.H.; Wenger, D.F.; Reyes, P.; Guidotti, K.; and others. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 2, 448-463(15 Jan 1989).

We have examined the effect of illuminating the anode in the Applied-B ion diode in Sandia's PBFA-I accelerator with 60—100 kW/cm² of extreme-ultraviolet (XUV) photons a few hundred nanoseconds prior to the accelerator shot. We find that XUV illumination significantly shortens the turn-on time of the ion beam, especially under conditions in which the normal "flashover" ion-source mechanisms are suppressed. In addition to the anticipated XUV photodesorption and photoionization of the anode material, some of the improvement seen with XUV illumination may be due to photoejection of electrons from the power feeds and their subsequent interaction with the anode source. Also, XUV illumination of a fine polypropylene weave located at the virtual cathode radius can preform the virtual cathode, dramatically reducing the turn-on time of the ion beam in the diode.

10519 **Gas utilization in the Tokamak Fusion Test Reactor neutral beam injectors.** Kamperschroer, J.H.; Gammel, G.M.; Kugel, H.W.; Grisham, L.R.; Stevenson, T.N.; von Halle, A.; Williams, M.D.; Jones, T.T.C. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 83-89(Jan 1989).

Measurements of gas utilization were performed using hydrogen and deuterium beams in the Tokamak Fusion Test Reactor (TFTR) neutral beam test beamline to study the feasibility of operating tritium beams with existing ion sources under conditions of minimal tritium consumption. (i) It was found that the fraction of gas molecules introduced into the TFTR long-pulse ion sources that are converted to extracted ions (i.e., the ion source gas efficiency) was higher than with previous short-pulse sources. Gas efficiencies were studied over the range 33%—55%, and its effect on neutralization of the extracted ions was studied. At the high end of the gas efficiency range, the neutral fraction of the beam fell below that predicted from room-temperature molecular gas flow (similar to observations at the Joint European Torus). (ii) Beam isotope change studies were performed. No extracted hydrogen ions were observed in the first deuterium beam following a working gas change from $H_2$ to $D_2$. There was no arc conditioning or gas injection preceding the first beam extraction attempt. (iii) Experiments were also performed to determine the reliability of ion source operation during the long waiting periods between pulses that are anticipated during tritium operation. It was found that an ion source conditioned to 120 kV could produce a clean beam pulse after a waiting period of 14 h by preceding the beam extraction with several acceleration voltage/filament warm-up pulses. It can be concluded that the operation of up to six ion sources on tritium gas should be compatible with on-site inventory restrictions established for D—T, Q = 1 experiments on TFTR.

10520 **Measurements of neutral beam species, impurities, spatial divergence, energy dispersion, pressure, and reionization using the TFTR U.S. Common Long Pulse Ion Source.** Kugel, H.W.; Gammel, G.M.; Grisham, L.R.; Kaita, R.; Kamperschroer, J.H.; Langley, R.A.; Magee, C.W.; Medley, S.S.; Murphy, T.J.; Roquemore, A.L.; and others. (Princeton Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, New Jersey 08543). *Review of Scientific Instruments;* **60**: No. 1, 37-52(Jan 1989).

Results are given from the first comprehensive and complementary measurements using the final production U.S. Common Long Pulse Ion Sources mounted on both the TFTR neutral beam test beamline and the TFTR neutral beam injection system, with actual tokamak experimental conditions, power systems, controls, and operating methods. The set of diagnostics included water calorimetry, thermocouples, vacuum ionization gauges, photodiodes, neutron, gamma-ray, and charged particle spectroscopy, optical multichannel analysis, charge exchange spectroscopy, Rutherford backscatter spectroscopy, and implantation/secondary ion mass spectroscopy. These systems were used to perform complementary measurements of neutral beam species, impurities, spatial divergence, energy dispersion, pressure, and reionization. The measurements were performed either in the neutralizer region, where the beam contained both ions and neutrals, or in the region of the output neutral beam. The average of the neutral particle ratios in the range from 80 to 114 keV is $D^0[E]:D^0[E/2]:D^0[E/3]$ = 53(5):27(4):20(4), where the quantities in parentheses are the average experimental uncertainties.

10521 **In situ spectroscopic erosion yield measurement with applications to sputtering and surface morphology alterations.** Leung, W.K.; Hirooka, Y.; Conn, R.W.; Goebel, D.M.; Labombard, B.; Nygren, R. (Mechanical, Aerospace and Nuclear Engineering Department and Institute of Plasma and Fusion Research, University of California, Los Angeles, California 90024). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 1, 21-26(Jan 1989).

An in situ spectroscopic erosion yield measurement is developed and used to monitor material surface erosion during bombardment by a plasma. The experiments are performed in a plasma that has the characteristics of a fusion tokamak boundary plasma but the technique is applicable to many processes where plasma erosion is important. Erosion yield of materials bombarded in a high flux (up to $10^{18}$ ion/cm² s) plasma environment has been previously studied using weight loss measurements. In the present study, the sputtered flux from a material is monitored by the line emission intensities of atoms eroded from the surface. The line intensities can be used to infer erosion yields after proper calibration. The method agrees well with results from weight loss measurements. Earlier work established that the material surface structure can substantially influence the erosion yield. When a change of surface morphology (e.g., cone formation) occurs, weight loss methods cannot be used to determine the erosion yield. However, the in situ erosion measurement is suitable and is used to investigate the relation between the onset of morphology changes and alternations in erosion yield during plasma bombardment. Experiments are reported for copper, as an example of a pure material, and stainless steel, as an example of an alloy system. The formation of surface cones is observed only when both the sample temperature is above a critical value and surface impurities exist. If the source of impurities is removed, or the sample temperature is lowered below the critical value, a surface rough with cones will be returned to a smooth state.

10522 **Modular tokamak magnetic system.** Yang, T.F. (to Dept. of Energy, Washington, DC). US Patent 4,774,048. 27 Sep 1988. Filed date 20 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a tokamak reactor including a vacuum vessel, toroidal confining magnetic field coils disposed concentrically around the minor radius of the vacuum vessel, and poloidal confining magnetic field coils, an ohmic heating coil system comprising at least one magnetic coil disposed concentrically around a toroidal field coil, wherein the magnetic coil is wound around the toroidal

field coil such that the ohmic heating coil enclosed the toroidal field coil.

10523 **Neutron imaging of laser fusion targets.** Ress, D.; Lerche, R.A.; Ellis, R.J.; Lane, S.M.; Nugent, K.A. (Lawrence Livermore National Lab., CA (USA)). *Science (Washington, D.C.);* **241**: 956-958(19 Aug 1988).

A long-term goal of inertial-confinement fusion research is the generation of energy by imploding capsules containing deuterium-tritium fuel. Progress in designing the capsules is aided by accurate imaging of the fusion burn. Penumbral coded-aperture techniques have been used to obtain neutron images that are a direct measurement of the fusion burn region in the capsules. 8 references, 4 figures.

10524 **Skyshine study for next generation of fusion devices.** Gohar, Y.; Yang, S. (Argonne National Lab. (US)). pp 191-196 of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A shielding analysis for next generation of fusion devices (ETR/INTOR) was performed to study the dose equivalent outside the reactor building during operation including the contribution from neutrons and photons scattered back by collisions with air nuclei (skyshine component). Two different three-dimensional geometrical models for a tokamak fusion reactor based on INTOR design parameters were developed for this study. In the first geometrical model, the reactor geometry and the spatial distribution of the deuterium-tritium neutron source were simplified for a parametric survey. The second geometrical model employed an explicit representation of the toroidal geometry of the reactor chamber and the spatial distribution of the neutron source. The MCNP general Monte Carlo code for neutron and photon transport was used to perform all the calculations. The energy distribution of the neutron source was used explicitly in the calculations with ENDF/B-V data. The dose equivalent results were analyzed as a function of the concrete roof thickness of the reactor building and the location outside the reactor building.

# 99 GENERAL AND MISCELLANEOUS

*REFER ALSO TO CITATION(S) 8603, 10586*

10525 **(INIS-mf—11845) Karlsruhe Nuclear Research Center. Progress report on research and development work in 1987.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 19 May 1988. 478p. (In German). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88756099/JAW.

This summary of R and D work is the scientific annual report to be prepared by the research center in compliance with its statutes. The material is arranged by items of main activities, as given in the overall R and D programme set up for the research center. The various reports prepared by the individual institutes and principal departments are presented under their relevant subject headings. The annual report is intended to demonstrate the progress achieved in the tasks and activities assigned by the R and D programme of the research center, by referring to the purposes and goals stated in the programme, showing the joint or separate efforts and achievements of the institutes. Details and results of activities are found in the scientific-technical publications given in the bibliographical survey, and in the internal primary surveys. The main activities of the research center include the following: Fast Breeder Project (PSB), Nuclear Fusion Project (PKF), Separation Nozzle Project (TDV), and Reprocessing and Waste Treatment Project (PWA), Ultimate Disposal of Radioactive Waste (ELA), Environment and Safety (U and S), Solids and Materials (FM), Nuclear and Particle Physics (KTP), Microtechniques (MT), Materials Handling (HT), Other Research Activities (SF). Organisational aspects and institutes and the list of publications conclude the report.

10526 **(LA—11455-MS) Long rod impacts on oblique plates: Three-dimensional calculations with HULL.** Fujita, R.K.; Cort, G.E. (Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 18p. NTIS, PC A03 - OSTI. Order Number DE89004393/JAW.

The justification for three-dimensional versus two-dimensional simulations of nonsymmetric armor penetration problems has been a topic of discussion for many years. Two-dimensional plain-strain approximations are generally not quantitatively accurate, especially at later times. Although three-dimensional calculations provide better results, they are very time consuming and expensive to perform. But with the improved speed and memory capabilities of modern computers, it is now more feasible to perform three-dimensional calculations. In this study, we compare two- and three-dimensional Eulerian calculations performed with the HULL hydrodynamic computer code with experimental data from normal and oblique impacts of uranium 0.75 wt % titanium penetrators into rolled homogeneous armor. 5 refs., 12 figs., 4 tabs.

## 9901 Management

*REFER ALSO TO CITATION(S) 7512, 7868, 8104*

10527 **(CONF-8810187—5) Decision support for financial forecasting.** Jairam, B.N.; Morris, J.D.; Emrich, M.L.; Hardee, H.K. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89002322/JAW.

From 24. annual meeting of the Institute of Management Science - Southeastern Chapter; Myrtle Beach, SC, USA (6 Oct 1988).

A primary mission of the Budget Management Division of the Air Force is fiscal analysis. This involves formulating, justifying, and tracking financial data during budget preparation and execution. An essential requirement of this process is the ready availability and easy manipulation of past and current budget data. This necessitates the decentralization of the data. A prototypical system, BAFS (Budget Analysis and Forecasting System), that provides such a capability is presented. In its current state, the system is designed to be a decision support tool. A brief report of the budget decisions and activities is presented. The system structure and its major components are discussed. An insight into the implementation strategies and the tool used is provided. The paper concludes with a discussion of future enhancements and the system's evolution into an expert system. 4 refs., 3 figs.

10528 **(DOE/IG—0260) The severance pay issue at the Savannah River Plant.** (USDOE Office of Inspector General, Oak Ridge, TN. Eastern Regional Office). 21 Nov 1988. 13p. H. Order Number TI89004214/JAW.

Report to The Secretary.

Attached is a copy of the audit report on the Severance Pay Issue at the Savannah River Plant. The report includes the finding and recommendation that were presented in our Flash Report ER-F-88-01, "The Severance Pay Issue at the Savannah River Plant," issued April 11, 1988. The objective of the audit was to determine whether the Department should reimburse Du Pont for $75 million in severance payments.

10529 **(GEPP-TIS—1140) Resource planning model.** Kratzer, E.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). Dec 1988. Contract AC04-76DP00656. 11p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004975/JAW.

The Resource Planning Model is a computer software application developed using ORACLE relational database software. The model maintains database records on-line which can be used interactively through on-line transactions. The model produces reports which detail manpower requirements. The Resource Planning Model takes a manufacturing schedule in terms of product, quantity, and time frame and, using specific data about work areas and products, converts the schedule into manpower requirements in terms of work area, labor hours, and time frame. 9 figs.

**10530 (INFO—0197) Evaluation of the AECB's process of consultation with employees of its licensees.** Hart, D.; Eedy, W.; Hostovsky, C.; Burt, A.J.; Maghy, R. (Beak Consultants Ltd., Toronto, Ontario (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1986. 167p. NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705121/JAW.

The study involved a review of public consultation methods used by various Federal Government agencies. These were then compared to the existing AECB programs to evaluate potential improvements. These were also referred to in later surveys of employees at licensed facilities to determine their perceived appropriateness. The majority of employees were both aware of AECB and correctly understood its function. Both of these aspects increased as a function of union membership, age, income, male sex and ARW status. However, the use of AECB consultative documents declined with union membership and increased with membership in professional associations. Satisfaction with the AECB consultative process was fairly low. Workers tended to be more satisfied with other agencies or safety associations. Feelings of job safety were greatest among those who received consultative documents or read AECB press releases. Feelings of safety also increased with age, education, income and professional association membership, but declined with union membership. Unionized employees expressed a desire for more consultation with AECB. Recommendations to improve the process of consultation are included.

**10531 (INFO—0200) Methodologies for evaluation of AECB regulatory program.** Yarranton, G.A.; Gray, B.J.; Yarranton, M. (Yarranton Holdings Ltd., Calgary, Alberta (Canada)). (Atomic Energy Control Board, Ottawa, Ontario (Canada)). May 1986. 302p. NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS. Order Number DE88705124/JAW.

AECB (Atomic Energy Control Board) commissioned this report to obtain information about methods of planning and conducting evaluation of its regulatory program. The report begins with a bibliography consisting of 280 abstracts assembled from an extensive search of international literature. Each cited publication describes or uses methods applicable to the evaluation of regulatory programs. The report continues with a review of the methodologies found in the literature. It identifies the most relevant references for each step in program evaluation: the commissioning of evaluation; the identification of evaluation issues; the defining of questions; the answering of questions; the reporting of reslts, and the implementation of recommendations. Finally, the report examines the applicability, advantages and disadvantages of the different evaluation methods and makes recommendations about the selection of methods and their application to the AECB program.

**10532 (INIS-mf—11326) Progress report 1986-1987 of the Reaktorinstitut Graz.** Mueller, H. (ed.). (Verein zur Foerderung der Anwendung der Kernenergie, Graz (Austria). Reaktorinstitut). Jun 1988. 24p. (In German). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE88704916/JAW.

Abstracts of work done or still in progress in the fields: reactor physics and neutron physics; neutron dosimetry; radiation measuring technique; radionuclide transfer and inner dosimetry. The larger part of the contributions has been already published or presented at conferences. Moreover three gamma measuring installations are described that has been used on fallout - and related measurements - from the Chernobyl accident. 3 figs. (qui).

**10533 (SAND—88-2967C) Through the looking glass: A look at training in the 1990's and beyond.** Hutchison, C.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-8811101—3). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003142/JAW.

From 12. annual TRADE conference; San Francisco, CA, USA (7 Nov 1988).

This report overviews changing trends in our society and general methods of coping with these changes. Aspects of training needs and work force abilities are also covered. 33 refs. (JF)

## 9902 Mathematics And Computers

*REFER ALSO TO CITATION(S) 8603, 8687, 9947, 10592*

**10534 (AD-A—197101/9/XAB) Experiences with Poker.** Notkin, D.; Socha, D.; Snyder, L.; Bailey, M.L.; Forstall, B. (Washington Univ., Seattle (USA). Dept. of Computer Science). Apr 1988. 12p. NTIS, PC A03/MF A01.

Experience from over five years of building nonshared memory parallel programs using the Poker Parallel Programming Environment has positioned the authors to evaluate their approach to defining and developing parallel programs. This paper presents the more-significant results of the authors evaluation of Poker. This evaluation is driving the next effort in parallel programming environments; many of the results should be sufficiently general to apply to other related efforts.

**10535 (AD-A—197102/7/XAB) Achieving speedups for a shared-memory model language on an SIMD parallel computer. Technical report.** Greenlaw, R.; Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Sep 1987. 22p. (TR—87-09-03). NTIS, PC A03/MF A01.

The potential for speeding up a shared-memory model sequential programming language, APL, by using an idealized nonshared-memory parallel computer is investigated. The authors simulated the running of APL's dyadic, reduction, and subscript operators on a 4-connected mesh SIMD parallel computer. The simulation results indicate that these operations can be sped up significantly using parallelism. These findings support the thesis that parallelism can speedup a majority of typical APL (A Programming Language) programs and not just those programs that are especially suited to parallelization. The sequential APL language requires no sophisticated compilation techniques like Paraphase and PFC, because the operators in APL are inherently parallel. It is felt that exploiting this property of APL is interesting.

**10536 (AD-A—197197/7/XAB) Parallel debugging using graphical views. Technical report.** Bailey, M.; Socha, D.; Notkin, D. (Washington Univ., Seattle (USA). Dept. of Computer Science). Mar 1988. 13p. (TR—88-03-05). NTIS, PC A03/MF A01.

Graphical views are essential for debugging parallel programs because of the large quantity of state information contained in parallel programs. Voyeur, a prototype system for creating graphical views of parallel programs, provides a cost-effective way to construct such views for any parallel-programming system. We illustrate Voyeur by discussing four views created for debugging Poker programs. One is a general trace facility for any Poker program. The other three are tailored to display a specific type of algorithmic information. Each of these views has been instrumental in detecting bugs that would have been difficult to detect otherwise, yet were obvious with the views.

**10537 (AD-A—197290/0/XAB) Software architecture for network communication. Technical report, 7 August 1984-6 August 1987.** Anderson, D.P. (California Univ., Berkeley (USA). Dept. of Electrical Engineering and Computer Sciences). 30 Nov 1987. 22p. NTIS, PC A03/MF A01.

A distributed system is based on a layered set of abstractions of network communication. At a low level, current distributed systems use primitives such as datagrams, request/reply message passing, reliable virtual circuits, or a combination of these. Future distributed systems will use high-performance large-scale communication networks, and will support a range of communication-intensive applications. What are the appropriate communication abstractions for such systems. In answer to this question, the author developed a communication abstraction called Real-Time Message Streams (RMS). An RMS is a simplex (unidirectional) stream with several performance and security parameters. These parameters express 1) the needs of RMS clients (user programs and communication protocols), and 2) the capabilities of the RMS provider (network and higher layers). This information can be used in two ways. First, RMS providers can eliminate unnecessary or redundant work, and can optimally schedule resources such as network bandwidth and CPU. Second, the RMS client can use the parameters to select opti-

mal methods for achieving whatever reliability and flow control are needed. RMS is the communication primitive of the DASH distributed system currently being developed at UC Berkeley. This paper describes 1) the RMS abstraction itself, 2) the role of RMS and DASH communication architecture, and 3) techniques and algorithms for providing RMS at various system levels.

10538 **(AD-A—197341/1/XAB) Practical algorithms for image-component labeling on SIMD mesh connected computers.** Cypher, R.E.; Snyder, L.; Sanz, J.L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Dec 1987. 11p. (TR—87-12-05). NTIS, PC A03/MF A01.

Two new parallel algorithms are presented for the problem of labeling the connected components of a binary image, which is also known as the connected ones problem. The machine model is an SIMD two-dimensional mesh-connected computer consisting of an N x N array of processing elements, each containing a single pixel of an N x N image. Both new algorithms use a shrinking operation defined by Levialdi and have time complexities of O(N log N) bit operations, which makes them the fastest local algorithms for the problem. Compared with other approaches having similar or better time complexities, this local approach dramatically simplifies the algorithms and reduces the constants of proportionality by nearly two orders of magnitude, thus making them the first practical algorithms for the problem. The two algorithms differ in the amount of memory required per processing element; the first uses O(N) bits, while the second employs a novel compression scheme to reduce the requirement to O(log N) bits.

10539 **(AD-A—197410/4/XAB) Simulating synchronous processors. Technical report.** Welch, J.L. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Jun 1988. 18p. (MIT/LCS/TM—359). NTIS, PC A03/MF A01.

This paper shows how a distributed system with synchronous processors and asynchronous message delays can be simulated by a system with both asynchronous processors and asynchronous message delays in the presence of various types of processor faults. Consequently, the result of Fischer, Lynch and Paterson (1985), that no consensus protocol for asynchronous processors and communication can tolerate one failstop fault, implies a result of Dolev, Dwork, and Stockmeyer (1987), that no consensus protocol for synchronous processors and asynchronous communication can tolerate one failstop fault.

10540 **(AD-A—197574/7/XAB) Hypercube and shuffle-exchange algorithms for image-component labeling. Technical report.** Cypher, R.E.; Sanz, J.L.; Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Apr 1987. 8p. (TR—87-04-03). NTIS, PC A02/MF A01.

This paper presents algorithms for labeling the connected components of a binary image using a hypercube or shuffle-exchange computer. The algorithms label the components of an sq 1 + N x sq 1 + N pixel image in O(long sq of N) time using a hypercube or shuffle-exchange computer with N processors and a constant amount of memory per processor. The algorithms that are presented are the first to solve this problem in O(log sq of N) time. The algorithms are based on a divide-and-conquer approach and use as a subroutine an O(log N) time PRAM algorithm for labeling the connected components of a graph. The simulation of the PRAM by the hypercube and shuffle-exchange computers is particularly efficient because the PRAM that is being simulated has only O(N to the 3/4 power) processors and memory cells.

10541 **(AD-A—197838/6/XAB) Applications of parallelism to current algorithms for intelligence analysis. Final report.** Griesel, M.A.; Hughes, J.S.; Moore, B.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 10 Jul 1987. 23p. (JPL-D—4719). NTIS, PC A03/MF A01.

The purpose of this document is to detail a study of concurrent processing by the Concurrent Processing Subgroup of the U.S. Army Intelligence Center and School (USAMS) task in association with the Advanced Computing Research Facility (ACRF) at Argonne National Laboratory (ANL). The study centered on the effect of different concurrent architectures (hypercube and shared memory) on Intelligence and Electronic Warfare (IEW) algorithm performance. The study examines implementation of a spatial aggregation algorithm on a hypercube and a shared-memory machine with special attention given to data partitioning. The difference in implementation of the algorithm are due to data partitioning, data dependence, and communication between processors. Two parallel machines were used: The Cal Tech-JPL Mark II Hypercube, and the Sequent Balance at the Advanced Computing Research Facility at Argonne National Laboratory. The hypercube is a 32-node concurrent processor consisting of 32-identical processors linked by a communications network. The Sequent Balance is a high-performance, general-purpose computer system that uses 2 to 12 National Semi-conductor Series 32000 CPUs in a tightly-coupled multi-processing architecture. This study indicates that task oriented algorithms with a low degree of data interdependence are better suited to a shared memory implementation and data-driven algorithms to a hypercube implementation.

10542 **(AD-A—197859/2/XAB) Northeast Artificial Intelligence Consortium annual report 1986. The Versatile Maintenance Expert System (VMES) project. Volume 2. Interim report, January-December 1986.** Shapiro, S.C.; Srihari, S.N.; Taie, M.R.; Geller, J.; Campbell, S.S. (Northeast Artificial Intelligence Consortium, Syracuse, NY (USA)). Jun 1988. 135p. NTIS, PC A07/MF A01.

The Northeast Artificial Intelligence Consortium (NAIC) was created by the Air Force Systems Command, Rome AIr Development Center, and the Office of Scientific Research. Its purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the exploration of methods for developing a Versatile Maintenance Expert System (VMES).

10543 **(AD-A—197879/0/XAB) Parallel-processing techniques for the simulation of MOS VLSI circuits using waveform relaxation. Technical report, August 1985-June 1988.** Smart, D.W. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Jul 1988. 148p. (UILU-ENG—88-2237). NTIS, PC A07/MF A01.

Waveform relaxation algorithms for the simulation of MOS circuits exhibit natural parallelism, arising from the intrinsic partitioning of the circuit into subcircuits, which are solved separately during the iterative solution process. Investigated in this thesis is the extent to which the overall run time of a simulation can be reduced by utilizing the natural parallelism of waveform relaxation on parallel processors.

10544 **(AD-A—197952/5/XAB) Modified cyclic algorithms for solving triangular systems on distributed-memory multiprocessors.** Eisenstat, S.C.; Heath, M.T.; Henkel, C.S.; Romine, C.H. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). May 1988. 12p. NTIS, PC A03/MF A01.

Pub. in SIAM Journal of Scientific Statistics and Computing, Vol. 9, No. 3, 589-600(May 1988).

New parallel algorithms and comparative test results are given for solving triangular systems of linear equations on distributed-memory multiprocessors. These results supplement those given in a previous paper. All of the new algorithms are variations on the cyclic algorithms discussed previously. The new algorithms are shown to provide substantial performance improvements.

**10545 (AD-A—197957/4/XAB) Northeast Artificial Intelligence Consortium annual report 1986. Volume 3. Distributed artificial intelligence for communication network management. Interim report, January-December 1986.** Meyer, R.A.; Conry, S.E. (Syracuse Univ., NY (USA)). Jun 1988. 50p. NTIS, PC A03/MF A01.

See also Volume 4, AD-A197 958.

The Northeast Consortium conducts pertinent research in artificial intelligence and performs activities ancillary to this research. This report describes progress made in the second year of the existence of the consortium on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance and explanation system. The specific topic for this volume is the use of knowledge-based systems for communications network management and control via an architecture for a diversely distributed multi-agent system.

**10546 (AD-A—197958/2/XAB) Northeast Artificial Intelligence Consortium annual report 1986. Volume 4. Part A. Hierarchical region-based approach to automatic photointerpretation. Part B. Application of ai techniques to image segmentation and region identification. Interim report, January-December 1986.** Modestino, J.W.; Nagy, G. (Northeast Artificial Intelligence Consortium, Syracuse, NY (USA)). Jan 1988. 63p. NTIS, PC A04/MF A01.

See also Volume 3, AD-A197 957.

The Northeast Artificial Intelligence Consortium is purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications-system control, automatic photointerpretation, time-oriented problem solving, speech understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topics for this volume are the use of expert systems for automated photointerpretation and other AI techniques to image segmentation and region identification.

**10547 (AD-A—198034/1/XAB) Evaluation of computing capabilities of a hierarchy of mini-to-supercomputers: applications to ion-microscopic analysis. Technical report.** Ling, Y.C.; Bernardo, D.N.; Morrison, G.H. (Cornell Univ., Ithaca, NY (USA). Baker Lab.). 1988. 17p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemometrics, Vol. 2, 189-202(1988).

There has been a steadily increasing demand for more computational power in surface and interface analysis. This paper reports attempts to meet this demand through the use of different computing systems, ranging from minicomputer to supercomputer. Representative laboratory data-processing programs for ion-microscopic analysis are used to evaluate the performance of each system. The bottlenecks and other problems involved in running analytical programs on faster machines are identified and discussed. Results indicate that in order to attain the optimal cost-performance ratio, programs must be formulated to exploit available vector and parallel-processing capabilities.

**10548 (AD-A—198085/3/XAB) Northeast Artificial Intelligence Consortium annual report for 1986. Volume 1. Executive summary. Interim report, January-December 1986.** Weiss, V.; Brule, J.F. (Syracuse Univ., NY (USA)). Jun 1988. 38p. NTIS, PC A03/MF A01.

The Northeast Artificial Intelligence Consortium's (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress made in the second year of existence. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance and explanation systems.

**10549 (AD-A—198286/7/XAB) Northeast Artificial Intelligence Consortium annual report 1986. Volume 6. Part B. Knowledge-base maintenance using logic-programming methodologies. Interim technical report, January-December 1986.** Bowen, K.W. (Syracuse Univ., NY (USA)). Jun 1988. 69p. NTIS, PC A04/MF A01.

See also Part A, AD-A198 285.

The Northeast Artificial Intelligence Consortium (NAIC) was created to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications-system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the use of logic programming methodologies for knowledge-base maintenance.

**10550 (AD-A—198287/5/XAB) Northeast Artificial Intelligence Consortium annual report 1986. Volume 8. Part A. Time oriented problem solving. Interim technical report, January-December 1986.** Allen, J.F. (Syracuse Univ., NY (USA)). Jun 1988. 131p. NTIS, PC A07/MF A01.

See also Part B, AD-A198 597.

The Northeast Artificial Intelligence Consortium's (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report covered such topics as: versatile expert system for equipment maintenance, distributed AI for communications-system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge-base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is a model theory and axiomatization of a logic for reasoning about planning in domains of concurrent actions.

**10551 (AD-A—198312/1/XAB) Lattice-structured proof technique applied to a minimum spanning-tree algorithm. Technical report.** Welch, J.L.; Lamport, L.; Lynch, N. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Jun 1988. 199p. (MIT/LCS/TM—361). NTIS, PC A09/MF A01.

Highly-optimized concurrent algorithms are often hard to prove correct because they have no natural decomposition into separately provable parts. This paper presents a proof technique for the modular verification of such nonmodular algorithms. It generalizes existing verification techniques based on a totally-ordered hierarchy of refinements to allow a partially-ordered hierarchy - that is, a lattice of different views of the algorithm. The technique is applied to the well-known distributed minimum spanning-tree algorithm of Gallager, Humblet and Spira, which was until recently lacked a rigorous proof.

**10552 (AD-A—198341/0/XAB) Explanation mechanisms for knowledge-based models in the RAND Strategy Assessment System. Interim report.** David, P.K. (RAND Corp., Santa Monica, CA (USA)). Aug 1988. 58p. (RAND/N—2711-NA). NTIS, PC A04/MF A01.

This user's manual for understanding the behavior of knowledge-based decision models written in the RAND-ABEL programming language and incorporated in the RAND Strategy Assessment System (RSAS) teaches the user how to use the RSAS explanation mechanisms. The limiting factor is often the user's intuition about where to look for the evaluation of variables determining the values of higher-level variables in the RSAS's hierarchical models. Success depends on a top-down understanding of the models (since the RSAS knowledge-based programs are structured to match the con-

ceptual models). Summary procedures that work well and efficiently assist the user.

10553 **(AD-A—198392/3/XAB) Design, implementation, building, and evaluation of a Torus Double Transitive Closure Network of Transputers. Master's thesis.** Frazao Sasa, J.I. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 169p. NTIS, PC A08/MF A01.

Currently the design of highly parallel supercomputers is one of the most-challenging problems in engineering. The purpose of this thesis is to describe how the problem was approached in the design, implementation, and building of a Torus Double Transitive Closure Network of Microprocessors, using the T414 Transputer as the basic Unit of Computation. Also compares the performance of the evolved model, from one Transputer to the final stage of sixteen Transputers running in parallel. All the programs and examples presented in this thesis were implemented in the OCCAM2 Programming Language, using the Transputer Development System, D700c, BETA 2.0 release March 1987 compiler version.

10554 **(AD-A—198530/8/XAB) Evaluation of work-distribution algorithms and hardware topologies in a multi-transputer network. Master's thesis.** Cloughley, W.R. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 97p. NTIS, PC A05/MF A01.

This thesis presents the evaluation of work-distribution algorithms and hardware topologies in a multi-Transputer network. The primary emphasis concerns a work-distribution algorithm known as work farm that is effective on problems that are divisible into independent work packets. All the programs and examples presented were implemented in the OCCAM programming language, using the Transputer Development System, D700C, Beta 2.0 March 1987 compiler version.

10555 **(AD-A—198597/7/XAB) Northeast Artificial Intelligence Consortium annual report, 1986. Volume 8. Part B. Parallel, structural, and optimal techniques in vision. Interim technical report, January-December 1986.** Brown, C.M. (Syracuse Univ., NY (USA)). Jun 1988. 236p. NTIS, PC A11/MF A01.

See also Part A, AD-A198 287.

The Northeast Artificial Intelligence Consortium's purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. These volumes describe progress that has been made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. This part addresses various aspects of parallel, structural, and optimal techniques in computer vision.

10556 **(AD-A—198656/1/XAB) Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements. Annual report, 1 January-31 December 1987.** Schafer, R.W.; Paris, D.T. (Georgia Inst. of Tech., Atlanta (USA). School of Electrical Engineering). 1 Jan 1988. 43p. NTIS, PC A03/MF A01.

Specific topics covered are: digital signal processing, parallel-processing architectures, two-dimensional optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near and far-field transformations. Contents include: Periodic Scheduling Theory for DSP Multiprocessors; Zero-Reflectivity Surface Relief Gratings on Lossy Materials; Shaped Edge Serrations for Improved Reflector Performance; Iterative Signal Restoration and Estimation; Representation, Coding, and Analysis of Image; Multiprocessors for Digital Signal Processing; Two-Dimensional Optical Information Processing; Two-Dimensional Optical/Electronic Signal Processing; Electromagnetic Measurements in the Time and Frequency Domains; and Automated Measurements for Near- and Far-Field Transformations.

10557 **(AD-A—198697/5/XAB) Experimental study of methods for parallel preconditioned Krylov methods. Research report.** Baxter, D.; Saltz, J.; Schultz, M.; Eisenstat, S.; Crowley, K. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Jun 1988. 26p. (YALEU/DCS/RR—629). NTIS, PC A03/MF A01.

High-performance multiprocessor architectures differ both in the number of processors, and in the delay costs for synchronization and communication. In order to obtain good performance on a given architecture for a given problem, adequate parallelization, good balance of load and an appropriate choice of granularity are essential. This document discusses the implementation of parallel version of PCGPAK for both shared-memory architectures and hypercubes. The authors' parallel implementation is sufficiently efficient to allow them to complete the solution of the test problems on 16 processors of the Encore Multimax/320 in an amount of time that is a small multiple of that required by a single head of a Cray X/MP, despite the fact that the peak performance of the Multimax processors is not even close to that of the supercomputer range. The authors illustrate the effectiveness of the approach on a number of model problems from reservoir engineering and mathematics.

10558 **(AD-A—199030/8/XAB) Adaptive Gaussian pattern classification. Final report.** Priebe, C.E.; Marchette, D.J. (Naval Ocean Systems Center, San Diego, CA (USA)). Aug 1988. 46p. (NOSC/TD—1335). NTIS, PC A03/MF A01.

A massively parallel architecture for pattern classification is described. The architecture is based on the field of density estimation. It makes use of a variant of the adaptive-kernel estimator to approximate the distributions of the classes as a sum of Gaussian distributions. These Gaussians are learned using a moved-mean, moving-covariance learning scheme. A temporal ordering scheme is implemented using decay at the input level, allowing the network to learn to recognize sequences. The learning scheme requires a single pass through the data, giving the architecture the capability of real-time learning. The first part of the paper develops the adaptive-kernel estimator. The parallel architecture is then described, and issues relevant to implementation are discussed. Finally, applications to robotic sensor fusion, intended word recognition, and vision are described.

10559 **(AD-A—199112/4/XAB) Computer architecture for Kalman filtering. Final technical report, 10 September 1987-9 March 1988.** Travassos, R.H. (Systolic Systems, Inc., San Jose, CA (USA)). 9 Mar 1988. 61p. NTIS, PC A04/MF A01.

Highly parallel architectures are developed to meet the increasingly demanding throughput requirements of DoD signal-processing applications. In particular, to perform multi-dimensional Kalman filtering at sample rates approaching 15 kHz, innovative techniques are presented to partition the problem for real-time implementation. A unique decoupling of the predictor and corrector equations in the Kalman filter is developed to speed up computations by two (2) orders of magnitude (100x). The proposed parallel algorithms and architectures are well suited for recursive filtering and image and signal processing for next-generation instrument radar and telemetry equipment.

10560 **(AD-A—199438/3/XAB) Instruction sets for Parallel Random Access Machines. Doctoral thesis.** Trahan, J.L. (Illinois Univ., Urbana (USA). Coll. of Engineering). Aug 1988. 172p. (UILU-ENG—88-2249). NTIS, PC A08/MF A01.

An important model of parallel computation is the Parallel Random Access Machine (PRAM), which comprises multiple processors that execute instructions synchronously and share a common memory. Formalized by Fortune and Wyllie (1978) and Goldschlager (1982), the PRAM is a much more natural model of parallel computation than older models such as combinational circuits and alternating Turing machines (Ruzzo, 1981) because the PRAM abstracts the salient features of a modern multiprocessor computer. Eventually an algorithm developed for the PRAM can be implemented on a parallel network computer such as a mesh-connected

array computer (Thompson and Kung, 1977), a hypercube machine (Seitz, 1985), a cube-connected cycles machine (Preparata and Vuillemin, 1981) or a bounded degree processor network (Alt et al., 1987); on all network computers the routing of data complicates the implementation of algorithms. The PRAM provides the foundation for the design of highly parallel algorithms (Luby, 1986; Miller and Reif, 1985; among many others). This model permits the exposure of the intrinsic parallelism in a computational problem because it simplifies the communication of data through a shared memory. To quantify differences in computational performance, the time complexities of simulations between PRAMS with different instruction sets are determined. Focus is on the computational complexity of simulations between PRAMs with the following operations: multiplication, division, arbitrary left shift, arbitrary right shift, and probabilistic choice.

**10561 (ANL-HEP-CP—88-77) Prototype VME data acquisition card for the ZEUS calorimeter.** Dawson, J.W.; Berg, J.S.; Schlereth, J.L.; Stanek, R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. (CONF-881103—21). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004211/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

This paper discusses the design of a prototype data acquisition (DAQ) card for the ZEUS calorimeter. The card accepts two multiplexes analog data streams at a 1 MHz rate, and digitizes and stores the data for subsequent transfer through VME to a host computer. The data is buffered by a high-speed asynchronous FIFO following the A/D converters, and written into Data Memory on the card, either directly or after processing by an on-board digital signal processor (DSP). Each card has a 16-bit control-status register (CSR), the bits of which configure the hardware and define the hardware options. The 1/4 Mbyte of high speed CMOS static RAM appears either as a FIFO, or mapped memory depending upon a bit in the CSR. The card is designed to make use of the 32-bit data and address buses supported by VME, and accordingly can be most efficiently utilized in conjunction with a processor in the VME environment such as the 68020, which supports longword transfers in a 32-bit address space. The card is constructed on a ten layer printed circuit, with almost all components being surface-mount devices. All logic is implemented in PLD's. 5 refs., 4 figs., 3 tabs.

**10562 (CONF-8805143—1) Knowledge-based techniques in software engineering.** Jairam, B.N.; Agarwal, A.; Emrich, M.L. (Oak Ridge National Lab., TN (USA)). 4 May 1988. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01 - OSTI. Order Number DE88015318/JAW.

From CASE studies conference; Ann Arbor, MI, USA (23 May 1988).

Recent trends in software engineering research focus on the incorporation of AI techniques. The feasibility of an overlap between AI and software engineering is examined. The benefits of merging the two fields are highlighted. The long-term goal is to automate the software development process. Some projects being undertaken towards the attainment of this goal are presented as examples. Finally, research on the Oak Ridge Reservation aimed at developing a knowledge-based software project management aid is presented. 25 refs., 1 tab.

**10563 (CONF-8810187—4) Expert system for LAN media selection.** Johnson, M.L.; Bratten, W.A.; Williams, J.M.; Emrich, M.L. (Oak Ridge National Lab., TN (USA). Data Systems Research and Development Program). Oct 1988. Contract AC05-84OR21400. 4p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89002324/JAW.

From 24. annual meeting of the Institute of Management Science - Southeastern Chapter; Myrtle Beach, SC, USA (6 Oct 1988).

A continued rise in interconnectivity requirements and a shortage of experienced system integrators characterize a growing need for access to data networking information. Telecommunications personnel must make complex decisions regarding transfer media and topology. Informed decision making can be aided by an expert system capturing network planning knowledge. The LAN system has a modular architecture. It contains information regarding the design of Local Area Networks, as well as cost and time considerations. In addition, by including information regarding local constraints (e.g., equipment and distance), the system can be tailored to a new organization. 10 refs., 2 figs.

**10564 (DOE/ER/25026—25) Accuracy increase in waveform relaxation.** Juang, F. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1988. Contract FG02-87ER25026. 49p. (UILU-ENG—88-1772; UIUCDCS-R—88-1466). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004936/JAW.

Waveform relaxation is an iterative technique used to solve systems of ordinary differential equations. The method has been shown to converge superlinearly on finite intervals. In this report the order of accuracy of an iterate generated by the waveform relaxation method is characterized by the number of correct terms in its Taylor series expansion. We show that the order of accuracy is increasing in waveform relaxation and the increase after each iteration can be improved by careful splitting. In the Gauss-Seidel approach, after each iteration the accuracy increase is bounded by the cycle lengths in a system's dependency graph. 13 refs.

**10565 (DOE/ER/25045—T2) A preliminary numerical evaluation of a parallel algorithm for approximating the values and subgradients of the recourse function in a stochastic program with complete recourse.** Lessor, K.S. (Washington State Univ., Pullman (USA)). 26 Aug 1988. Contract FG06-87ER25045. 27p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89005244/JAW.

The parallel algorithm of Ariyawansa, Sorensen, and Wets for approximating the values and subgradients of the recourse function in a stochastic program with complete recourse is implemented and timing results are reported for limited experimental trials. 14 refs., 6 figs., 8 tabs.

**10566 (DOE/ER/25052—1) [Ultracomputer project]: Progress, 1988.** (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1988. Contract FG02-88ER25052. 9p. NTIS, PC A02/MF A01 - OSTI. Order Number DE89004863/JAW.

This paper discusses progress on the ultracomputer project in the following areas: operating systems, debugging, algorithms, environment, network simulation, analytical modeling of network behavior, random number generation for parallel computers, architecture, applications, and programming language design. (LSP)

**10567 (INIS-mf—11327, pp 24) Convenient expression of the Green-function in two-crystals neutron interferometry.** Guigay, J.P. (Centre National de la Recherche Scientifique, 38 - Grenoble (France). Lab. Louis Neel). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704917/JAW. (CONF-8709331—).

From International workshop on matter wave interferometry in the light of Schroedinger's wave mechanics - satellite workshop to the Schroedinger symposium; Vienna, Austria (14 Sep 1987).

**10568 (JAERI-M—88-184) OSCAR, a code for the calculation of the yield of radioisotopes produced by charged-particle induced nuclear reactions.** Hata, Kentaro; Baba, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756066/JAW.

A computer code OSCAR, operated on a main frame computer was developed for the calculation of the yield of radioisotopes produced by charged-particle induced nuclear reactions. The excitation functions required for calculating the yield were evaluated by means of an empirical rule which we developed on the basis of a systematics derived from a number of experimental data reported in the literature. The rule is valid for light ion ($Z \leqq 2$)-induced reactions followed by neutron emission processes. Other excitation functions are also obtainable from the data file in OSCAR. In addition, the code possesses functions useful for the calculation of the stopping power and range. The energy loss and the distribution of recoil products in stacked targets are also provided as options. The formalism, structure, and direction for the usage of the

code are described together with the explanation of the functions of some routines.

10569 **(LA—11363-MS) An infinite element for the ABAQUS finite element code.** Girrens, S.P.; Bennett, J.G. (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 24p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004544/JAW.

Both two-dimensional and three-dimensional infinite element capabilities were developed for incorporation into version 4.6 of the ABAQUS finite element structural mechanics code. The procedures developed are specific to the "user-defined element" option available in version 4.6. The theoretical development for the infinite element was taken from the literature and is summarized in this report. Infinite test problems involving one-dimensional heat transfer, two- and three-dimensional plane strain elasticity, and three-dimensional frequency response were studied. The report presents the results of these analyses. 11 refs., 10 figs., 2 tabs.

10570 **(N—88-29327) Cooperating knowledge-based systems. Final report.** Feigenbaum, E.A.; Buchanan, B.G. (Stanford Univ., CA (USA)). Aug 1988. 22p. (NASA-CR—183109; NAS—1.26:183109). NTIS, PC A03/MF A01.

This final report covers work performed under Contract NCC2-220 between NASA Ames Research Center and the Knowledge Systems Laboratory, Stanford University. The period of research was from March 1, 1987 to February 29, 1988. Topics covered were as follows: (1) concurrent architectures for knowledge-based systems; (2) methods for the solution of geometric constraint satisfaction problems, and (3) reasoning under uncertainty. The research in concurrent architectures was co-funded by DARPA, as part of that agency's Strategic Computing Program. The research has been in progress since 1985, under DARPA and NASA sponsorship. The research in geometric constraint satisfaction has been done in the context of a particular application, that of determining the 3-D structure of complex protein molecules, using the constraints inferred from NMR measurements.

10571 **(N—88-29351) Second conference on artificial intelligence for space applications.** Dollman, T. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Aug 1988. 709p. (NASA-CP—3007; M—577; NAS—1.55:3007; CONF-8611219—). NTIS, PC A99/MF E03.

From Artificial intelligence for space applications; Huntsville, AL, USA (13 Nov 1986).

The proceedings of the conference are presented. This second conference on Artificial Intelligence for Space Applications brings together a diversity of scientific and engineering work and is intended to provide an opportunity for those who employ AI methods in space applications to identify common goals and to discuss issues of general interest in the AI community.

10572 **(N—88-30308) Supermap for Cray FORTRAN: a user's guide.** Guest, C.J. (Sterling Software, Palo Alto, CA (USA)). Feb 1986. 54p. (NASA-CR—177410; NAS—1.26:177410; TN—86-7104-101-23). NTIS, PC A04/MF A01.

This program produces a map giving an overall view of all components and attributes of a FORTRAN program unit run by Cray. Unlike the maps produced by the Cray FORTRAN compiler which relates only to a single module, this map relates to the entire program. It maps the usage of all variable and all commons used.

10573 **(N—88-30312) Performance prediction of concurrent systems.** Mak, V.W.K. (Stanford Univ., CA (USA)). Dec 1987. 160p. (NASA-CR—183175; NAS—1.26:183175; CSL-TR—87-344). NTIS, PC A08/MF A01.

Concurrent systems are computers that use multiple processors to solve a single problem. A means to predict the application performance on these systems is a useful tool in many areas of concurrent system research. A computationally efficient and accurate method to predict performance for a class of parallel computations on concurrent systems is described. A parallel computation is modeled as a task system with precedence relationships expressed as a series parallel directed acyclic graph. Resources in concurrent systems are modeled as service centers in queueing network models. Using these two models as inputs, the method outputs predictions of both the time to complete the computation and the concurrent system utilization. The algorithm used is based on the approximate Mean Value Analysis in queueing network modeling with extensions to model concurrency in the computation. The new algorithm was validated against both detailed simulation and actual execution on a commercial multiprocessor.

10574 **(N—88-30330) 1988 Goddard Conference on Space Applications of Artificial Intelligence.** Rash, J.; Hughes, P. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Aug 1988. 437p. (NASA-CP—3009; REPT—88B0212; NAS—1.55:3009; CONF-8805237—). NTIS, PC A19/MF A01.

From Goddard conference on space applications of artificial intelligence; Greenbelt, MD, USA (24 May 1988).

This publication comprises the papers presented at the 1988 Goddard Conference on Space Applications of Artificial Intelligence held at the NASA/Goddard Space Flight Center, Greenbelt, Maryland on May 24, 1988. The purpose of this annual conference is to provide a forum in which current research and development directed at space applications of artificial intelligence can be presented and discussed. The papers in these proceedings fall into the following areas: mission operations support, planning and scheduling; fault isolation/diagnosis; image processing and machine vision; data management; modeling and simulation; and development tools/methodologies.

10575 **(N—89-11287) CSM testbed software system: a development environment for structural analysis methods on the NAS CRAY-2.** Gillian, R.E.; Lotts, C.G. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1988. 46p. (NASA-TM—100642; NAS—1.15:100642). NTIS, PC A03/MF A01.

The Computational Structural Mechanics (CSM) Activity at Langley Research Center is developing methods for structural analysis on modern computers. To facilitate that research effort, an applications development environment has been constructed to insulate the researcher from the many computer operating systems of a widely distributed computer network. The CSM Testbed development system was ported to the Numerical Aerodynamic Simulator (NAS) Cray-2, at the Ames Research Center, to provide a high end computational capability. This paper describes the implementation experiences, the resulting capability, and the future directions for the Testbed on supercomputers.

10576 **(ORNL/TM—10685) Hypercube simulation on a local area network.** Dunigan, T.H. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004703/JAW.

We describe the structure and use of a distributed computing environment based on a hypercube programming model that runs on most UNIX systems with TCP/IP network support. The package uses a library of message-passing routines and multiple user processes, written in either C or FORTRAN, to provide an environment for the development and testing of algorithms for hypercube parallel processors simulated by a collection of computers on a local area network. Each node of the simulated hypercube is a workstation on the network. The simulator produces a trace file that can be used for debugging, performance analysis, or graphical display. 10 refs., 6 figs., 3 tabs.

10577 **(PB—88-250725/XAB) Experiences on a CRAY-2 (trade name) running UNICOS. Technical note.** Pernice, M. (National Center for Atmospheric Research, Boulder, CO (USA)). Aug 1988. 40p. (NCAR/TN—316-STR). NTIS, PC A03/MF A01.

The CRAY X-MP/48 at the National Center for Atmospheric Research (NCAR) was installed and became operational in the fourth quarter of 1986. By the end of the second quarter of 1988, the X-MP was saturated. It is expected that NCAR will replace the X-MP with the next generation supercomputer sometime in 1990-1992. The users of NCAR's computing facilities have been using

the batch-oriented Cray Operating System (COS) since the installation of NCAR's first CRAY-1 in 1977. Concerns have been expressed about the impact of UNIX on supercomputer performance, particularly on the performance of applications that require substantial amounts of input and output (I/O) operations.

**10578 (PB—88-251046/XAB) Transputer implementation of systolic arrays for model reduction.** Megson, G.M. (Rutherford Appleton Lab., Chilton (UK)). 18 May 1988. 25p. (RAL—88-048). NTIS, PC E03/MF E03.

A unified bi-directional linear systolic array for performing model reduction of feedback control systems using continued fractions is developed. The array is capable of computing the 1st, 2nd, and 3rd Cauer forms of the fraction and their associated inverses as well as the Routh stability criterion. Timing graphs presented indicate that a speed-up of 2-4 on 5 transputers is achieved for common problem ranges.

**10579 (PB—88-870423/XAB) Transputers and the OCCAM programming language. January 1975-October 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-October 1988.** (National Technical Information Service, Springfield, VA (USA)). Oct 1988. 144p. NTIS PC N01/MF N01.

Supersedes PB—88-850169.

This bibliography contains citations concerning the Inmos Transputer and the OCCAM programming language, also developed by Inmos. A transputer is a high-performance 32-bit computer on a chip, complete with interfaces and memory. It was designed as a building block component for use in parallel processing networks. The OCCAM language is used in a multiprocessor environment to direct data flow and processor communication. Citations are included that discuss theory, practical applications, and case studies. (This updated bibliography contains 328 citations, 125 of which are new entries to the previous edition.)

**10580 (PB—89-104194/XAB) Two-dimensional convolution subject to data-spreading algorithm. Report for August 1985-July 1986.** Chen, Y.C.; Wang, H.C. (National Tsing Hua Univ., Hsinchu (Taiwan)). 1986. 78p. NTIS, PC E05/MF E05.

An algorithm for two-dimensional convolution is proposed to be highly efficient and suitable for parallel processing, and a hardware of pipeline architecture is implemented to realize the algorithm. The implemented hardware is built on an IBM personal computer and acts as an auxiliary processor of the personal computer. This makes the dream come true that high speed, low-cost image processing is feasible on personal computers. The hardware executes two operations of two-dimensional convolution concurrently on an 256 x 256 image frame in less than 500 miniseconds. Several functions are available to users, and parameters such as weighting coefficients and threshold value are programmable. Various processing results of the image frame can be obtained by changing these parameters. Besides, horizontal and vertical edge detection can also be executed concurrently, with results available at the same time.

**10581 (SAND—87-3003) An external code interface for the PRONTO family of transient solid dynamics programs.** Taylor, L.M.; Flanagan, D.P. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004454/JAW.

An external code interface is defined which allows other transient applications to communicate with the PRONTO family of finite element programs. This interface is written in ANSI FORTRAN and allows an independent author to specify requirements for an external code to PRONTO. The interface is written such that updates to PRONTO will not require modifications to the external code. 8 refs.

**10582 (SAND—88-2074) TOOPLOT: A mesh plotting post-processor for ARTOO.** Swegle, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 80p. NTIS, PC A05 - OSTI. Order Number DE89004504/JAW.

TOOPLOT is the mesh plotting program for ARTOO, the automatically rezoning version of the two-dimensional Lagrangian wavecode TOODY. The code reads and plots from ARTOO dump files, using the RSCORS plot package. TOOPLOT was designed for ease of use, while maintaining complete user control over the plots the user may wish to produce. Free format input commands consist of descriptive English language phrases, which results in readable input files, and aids in memorizing command forms. Types of plots which may be produced include one-dimensional line plots (plots of the value of a variable along an I or J line), as well as two-dimensional mesh plots, color material plots, contour plots, and plots using a color scale or gray scale to indicate the value of a user-selected plot variable. Two-dimensional combined plots with different plot types on opposite sides of a symmetry axis are easily generated. Side scales which indicate the value of a given contour, color, or gray shade are automatically drawn for each type of plot on the frame. External data plotting and legend drawing options are also included. Extensive error checking is done and explanatory messages are issued when errors are detected. 3 refs., 12 figs.

**10583 (SOL—88-18) Track initialization in the multiple-object tracking problem.** Zikan, K. (Stanford Univ., CA (USA). Systems Optimization Lab.). Nov 1988. Contract FG03-87ER25028. 19p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004868/JAW.

The multiple-object tracking problem involves extraction of the trajectories of n moving points from (three) successive motion picture frames. In the track initialization part of the problem no previous history of track evolution is given. A definition of a "three-point metric" functional (analogous to the classical definition of distance) is put forward. For the best estimate of the trajectories, we partition the points from the frames into n triplets (based on the three successive frames) so that the average three-point "distance" is minimized. The physical intuition behind this approach is discussed and several equivalent mathematical programming formulations are given. A practical method proposed for solving of the problem is based on a Lagrangian relaxation technique, and, to a lesser degree, on the "pruning" of the tree of "subpartitions". On the basis of empirical evidence and experience from related work, we conjecture that, on average, $O(n^3)$ arithmetic operations are needed to obtain a solution. The problem of missing and spurious points in the images is also briefly discussed. A short summary and examples from simulated data experiments are given. 15 refs., 5 figs.

**10584 (UCID—21515) How crackers crack passwords or what passwords to avoid.** De Alvare, A.M. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1988. Contract W-7405-ENG-48. 10p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89003715/JAW.

Computer security is a growing concern in research, development, marketing, and most other areas of everyday life. The first and foremost task in computer security is to prevent unauthorized access to systems. This report tells how "crackers" (computer wizards who use their talents for illegal and destructive purposes) obtain access to computer systems and gives specific advice on how to prevent them from doing it. 11 refs., 5 tabs.

**10585 (UCID—21598) Discrete analogs of PDEs [partial differential equations] defined on rectangular lattices.** Olwell, K.; Garbarini, J.; Balaban, D. (Lawrence Livermore National Lab., CA (USA)). 10 Oct 1988. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89004985/JAW.

This paper addresses the need to automate the creation of numerical approximations to solutions of partial differential equations (PDEs). We introduce some concepts from the FIDIL language definition. Then, building on these concepts, we show how discrete analogs of PDEs may be defined on rectangular lattices. In particular, we develop discrete analogs for the gradient, divergence, and the Laplacian. 1 ref., 14 figs.

**10586 (UCRL—99730) Overview of low-cost map digitizing systems.** Walker, H. (Lawrence Livermore National Lab., CA (USA)). 4 Oct 1988. Contract W-7405-ENG-48. 47p. (CONF-8810243—1). NTIS, PC A03/MF A01 - OSTI. Order Number DE89002872/JAW.

From Improving the safety aspects of nuclear facilities: development of a real-time dose assessment model; Livermore, CA, USA (3 Oct 1988).

The information that is placed into computer map files may come from many sources. Increasingly, the data is processed directly from surveys and other observations. For example, with relatively minimal processing, LANDSAT data can be input into a raster database as a separate map overlay. However, most data currently requires substantial human interaction to create the necessary map information. While the direct input, or capture, of observational data for cartographic data bases is an area of focused research and development, the majority of data capture processing involves the input of already existing maps and photographs into computer form, i.e., digitizing. The purpose of this document is to provide an overview of the current market for low-cost digitizing systems. No recommendations are made for selection of a particular vendor; however, four packages are highlighted as meeting the minimal requirements for extracting map data to provide base maps for a small emergency response system. Other vendors of similar products that could, with somewhat more difficulty, be adapted to the stated requirements are included. This document is composed of four sections including: (1) a discussion of the basic terminology of digitizing systems; (2) a description of the minimal requirements for a map digitizing system; (3) short discussions of the most appropriate packages based on literature received; (4) copies of portions of the literature sent by the various vendors. This document is intended to function as an introduction into this market area for those who are unfamiliar with the digital mapping field.

**10587 (UCRL—99886) The strategic planning process.** Ranelletti, J.E. (Lawrence Livermore National Lab., CA (USA)). 31 Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-8809187—2). NTIS, PC A02/MF A01 - OSTI. Order Number DE89003175/JAW.

From Cray Users Group meeting; Tokyo, Japan (12 Sep 1988).

This paper describes a process by the Computation Department at the Lawrence Livermore National Laboratory to define the department's mission and strategic objectives for the future. The process takes into account the customer base of the support organization and focuses on the users requirements for the future. This information, along with an assessment of the resources needed, form the strategies required to manage a highly diversified organization in a fast changing environment. 3 figs.

**10588 (UCRL—99979) Observability conditions for angles-only tracking.** Payne, A.N. (Lawrence Livermore National Lab., CA (USA)). 31 Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-8810202—5). NTIS, PC A02/MF A01 - OSTI. Order Number DE89004045/JAW.

From 22. Asilomar conference on signals, systems and computers; Pacific Grove, CA, USA (30 Oct 1988).

This paper addresses the state-observability issue for the problem of three-dimensional angles-only tracking of a moving, possible accelerating target by a moving observer. Necessary and sufficient conditions for observability are rigorously established. It is also shown that other existing observability criteria are special cases of these conditions. 7 refs., 1 fig.

**10589 One-dimensional inhomogeneous Ising model with periodic boundary conditions.** Percus, J.K.; Zhang, M.Q. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 16, 11737-11740(1 Dec 1988).

In this paper, we focus on the essential difference between the inhomogeneous one-dimensional Ising model with open and periodic boundary conditions. We show that, although the profile equation in the periodic case becomes highly nonlocal, due to a topological collective mode, there exists a local free-energy functional in an extended space and one can solve the inhomogeneous problem exactly.

## 9903 Information Handling

*REFER ALSO TO CITATION(S) 7739, 7783, 7898, 7899, 7900, 8069, 8603, 9135, 9206, 9257, 9460, 9464, 9465, 9466, 9467, 9468, 10100, 10533, 10537, 10539, 10545, 10546, 10551, 10554, 10579*

**10590 (AD-A—197507/7/XAB) Design, implementation, and evaluation of an abstract programming and communications interface for a network of transputers. Master's thesis.** Bryant, G.R. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1988. 177p. NTIS, PC A09/MF A01.

This thesis presents the design, implementation, and evaluation of two abstracted programming and communication interfaces for developing distributed programs on a network of Transputers. One interface uses a shared-memory model for interprocess communication and synchronization. The other interface uses a message-passing model for communication and synchronization. The programming interfaces allow development of distributed programs that are independent of the physical configuration of a network. This thesis also presents an evaluation of Transputer performance with a particular emphasis on the interaction of computation and inter-Transputer communication. The Transputer is a single-chip microprocessor specifically designed to function as a computing element in a distributed multicomputer system. As the transistor was a building block for large and varied electronic circuits, the Transputer is intended by the manufacturer to be an analogous building block for distributed computing systems. To facilitate the use of the Transputer as an element in a distributed system, the Transputer implements the concept of Communicating Sequential Processes. Communicating Sequential Processes is a paradigm defines and describes the interaction of programs that execute in parallel (as is the case in a distributed system).

**10591 (AD-A—197810/5/XAB) Use of efficient broadcast protocols in asynchronous distributed systems. Doctoral thesis.** Schmuck, F.B. (Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science). Aug 1988. 137p. (CU-CSD-TR—88-928). NTIS, PC A07/MF A01.

Reliable broadcast protocols are important tools in distributed and fault-tolerant programming. They are useful for sharing information and for maintaining replicated data in a distributed system. However, a wide range of such protocols has been proposed. These protocols differ in their fault tolerance and delivery-ordering characteristics. There is a tradeoff between the cost of a broadcast protocol and how much ordering it provides. It is, therefore, desirable to employ protocols that support only a low degree of ordering whenever possible. This dissertation presents techniques for deciding how strongly ordered a protocol is necessary to solve a given application problem. It is shown that there are two distinct classes of application problems: problems that can be solved with efficient, asynchronous protocols, and problems that require global ordering. The concept of a linearization function is introduced that maps partially ordered sets of event to totally ordered histories. The author show how to construct an asynchronous implementation that solves a given problem if a linearization function for it can be found. He proves that, in general, the question of whether a problem has an asynchronous solution is undecidable; hence, there exists no general algorithm that would automatically construct a suitable linearization function for a given problem. Therefore, he considers an important subclass of problems that have certain commutativity properties. He presents techniques for constructing asynchronous implementations for this class.

**10592 (AD-A—198090/3/XAB) Random-access algorithms for multiuser computer communication networks. Doctoral thesis, 1 September 1986-31 August 1988.** Papantoni-Kazakos, P.; Paterakis, M. (Virginia Univ., Charlottesville (USA). Dept. of Electrical Engineering). Jul 1988. 125p. (UVA—525415/EE89/115). NTIS, PC A06/MF A01.

For many communication applications with time constraints (e.g., transmission of packetized voice messages), a critical performance measure is the percentage of messages transmitted within a given amount of time after their generation at the transmitting station. This report presents a random-access algorithm (RAA) suitable for time-constrained applications. Performance analysis demon-

strates that significant message-delay improvement is attained at the expense of minimal traffic loss. Also considered is the case of noisy channels. The noise effect appears at erroneously observed channel feedback. Error sensitivity analysis shows that the proposed random-access algorithm is insensitive to feedback channel errors. Window Random-Access Algorithms (RAAs) are considered next. These algorithms constitute an important subclass of Multiple-Access Algorithms (MAAs); they are distributive, and they attain high throughput and low delays by controlling the number of simultaneously transmitting users.

10593 **(AD-A—198951/6/XAB) Design and implementation of a controller and a host simulator for a relational replicated data-base system. Master's thesis.** Lyon, L.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 174p. (AFIT/CI/NR—88-61). NTIS, PC A08/MF A01.

Data-base machines and parallel data-base systems are becoming a viable alternative for handling transactions on voluminous data-bases especially with the declining cost of hardware. Data-base research has spawned a variety of parallel-processing architectures to improve the performance of database machines. However, many of these architectures are based upon unique hardware configurations and technologies including processor-per-track, processor-per-head, and off-the-disk designs. Alternative backend data-base systems will be utilized for processing transactions on voluminous data-bases. The complete performance analysis and design of RRDS is currently being carried out by a Ph.D. student at the University of Central Florida. RRDS supports the relational data model and consists of multiple processors running replicated copies of the data-base management system (DBMS) software on a partitioned data-base. The general hardware organization is composed of a controller and a collection of replicated computers which can be implemented as microcomputers or minicomputers.

10594 **(AD-A—199563/8/XAB) Distributed-computer communications in support of real-time visual simulations. Summary report, October 1987-September 1988.** Barrow, T.H.; Yurchak, J.M.; Zyda, M.J. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1988. 176p. (NPS—52-88-028). NTIS, PC A09/MF A01.

Complex visual simulations can strain the capability of a single work station. A mix of different workstations is often more economical than the use of a large processor for such simulations. Methods of communicating between such work stations are needed that allow the developer to spend effort on the simulation and not on communications. Simple protocols are developed to support broadcast and direct-connect communications between workstations using TCP/IP on an Ethernet network. Comparisons are made between broadcast and direct connect protocols.

10595 **(LA—11314-MS) Emerging nuclear suppliers.** Potter, W.C. (Los Alamos National Lab., NM (USA)). Jul 1988. Contract W-7405-ENG-36. 13p. (CNSS/Papers—13). NTIS, PC A03/MF A01 - OSTI. Order Number DE89004547/JAW.

The development of a data base created to track and compile information on international nuclear transactions is discussed. This paper is based on a talk given on May 4, 1987, at the Center for National Security Studies of the Los Alamos National Laboratory. The presentation was followed by a question and answer session, which is included with the paper.

10596 **(PB—89-108104/XAB) Bulletin board service: a tool for implementing parallel algorithms.** Schrander, A.J.; van Otten, J.W.; van Renesse, R. (Vrije Univ., Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica). Jun 1988. 43p. (IR—156). NTIS, PC E03/MF A01.

The paper describes the design and implementation of the bulletin-board system. A bulletin board is a tool for implementing parallel algorithms, offering process management, synchronization, and communication features. An experimental bulletin-board service was implemented on the Amoeba distributed operating system. To show its operation, the implementation of a simple parallel algorithm using a bulletin board has been described.

## 9904 Law

*REFER ALSO TO CITATION(S) 7922*

10597 **(SAAS-Mitt—87-04) Guideline on recognized additional qualifications of responsible staff members and inspectors in the field of nuclear energy application.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 6p. (In German). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705218/JAW.

The guideline which entered into force on 3 September 1987 governs the required additional qualifications of responsible staff members and inspectors for several fields of nuclear energy application.

## 9905 Civilian Defense

*REFER ALSO TO CITATION(S) 8665, 8731, 8990, 9136*

10598 **(AD-A—197452/6/XAB) Evaluation of computer-aided system design tools for SDI (Strategic Defense Initiative) Battle Management/C3 (command, control and communications) architecture development. Final report.** Fife, D.W.; Campbell, K.; Chludzinski, J.; Corcoran, N.; Gonzalez, C. (Institute for Defense Analyses, Alexandria, VA (USA)). 1 Oct 1987. 183p. (IDA-P—2062). NTIS, PC A09/MF A01.

This IDA paper was prepared at the request of the Strategic Defense Initiative Organization. The paper documents findings of an evaluation on the capabilities of certain computer software/computer-aided software engineering (CASE) tools to provide computer-aided graphic design of Battle Management/C3 for the SDIO. Each tool (of the five selected on the basis of the best available at this time), was installed at IDA. After training by vendor tool staff, an IDA team, using a hands-on design experience determined the merits of the tools for SDI application. A comparative summary of the tools is given relative to envisaged SDI requirements and an extensive questionnaire is answered for each.

10599 **(AD-A—197504/4/XAB) SDI (Strategic Defense Initiative) software technology program plan. Final report.** Linn, C.J.; Redwine, S.T.; Bloom, M.I.; Brykczynski, B.; Chludzinski, J. (Institute for Defense Analyses, Alexandria, VA (USA)). Jun 1987. 470p. (IDA-P—1926). NTIS, PC A20/MF A01.

This paper was prepared in response to a request from the Battle Management C3 office within the Strategic Defense Initiative Organization (SDIO) of the Department of Defense (DoD). The request was for a software-technology program plan to define software research and development (R&D) efforts required by the SDI, and to provide the basis for integrating the SDIO software technology program with ongoing non-SDIO programs. The paper emphasizes reviewing the ongoing software programs and plans within the DoD and academia. The reviews identify critical software technology areas required to meet the unique SDI requirements, and indicate priorities among the software technologies to meet attainability, productivity, and reliability goals, as well as functional performance objectives.

10600 **(AD-A—198322/0/XAB) Contamination Subpanel Report to the Phenomenology Panel of the SDIO (Strategic Defense Initiative Organization) midcourse sensors study. Final report, August 1987-February 1988.** Albright, P.C.; Murad, E.A. (Institute for Defense Analyses, Alexandria, VA (USA)). Mar 1988. 30p. (IDA-M—439). NTIS, PC A03/MF A01.

This memorandum report presents a brief summary of sensor-contamination issues relevant to the Midcourse Sensors Study of the Strategic Defense Initiative Organization.

10601 **(PB—89-100077/XAB) Analysis and re-design of event-driven simulation system in ADA.** Wengelin, D. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1988. 145p. (In Swedish). (FOA-C—20726-2.5). NTIS, PC E06/MF A01.

This paper conducts analysis of the existing air-defense system simulation software SILVIA. An improved simulation strategy, message-driven simulation, is proposed instead of the model used in current implementation of SILVIA. Message-driven simulation is an event-oriented simulation model, based on the token-passing principle. A mail box is implemented as the central unit in the system. The mail box performs message passing from one actor in the system to another. Each message is tagged with the simulated delivery time, and the mail box delivers messages in delivery time order. Hence, the mail-box performs the task of an ordinary scheduler, as well as its message-passing chores. Message-driven simulation combines high performance with abstraction and information hiding to form a powerful tool for the SILVIA system.